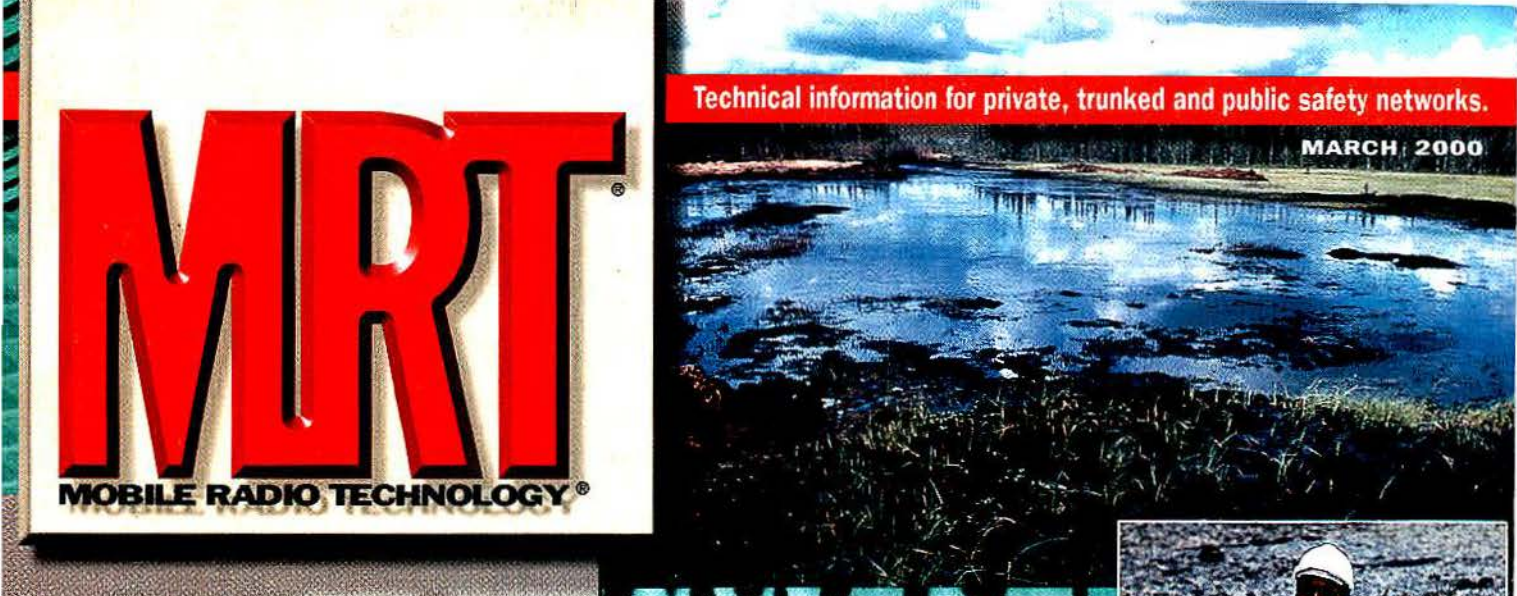
MRT

MOBILE RADIO TECHNOLOGY®

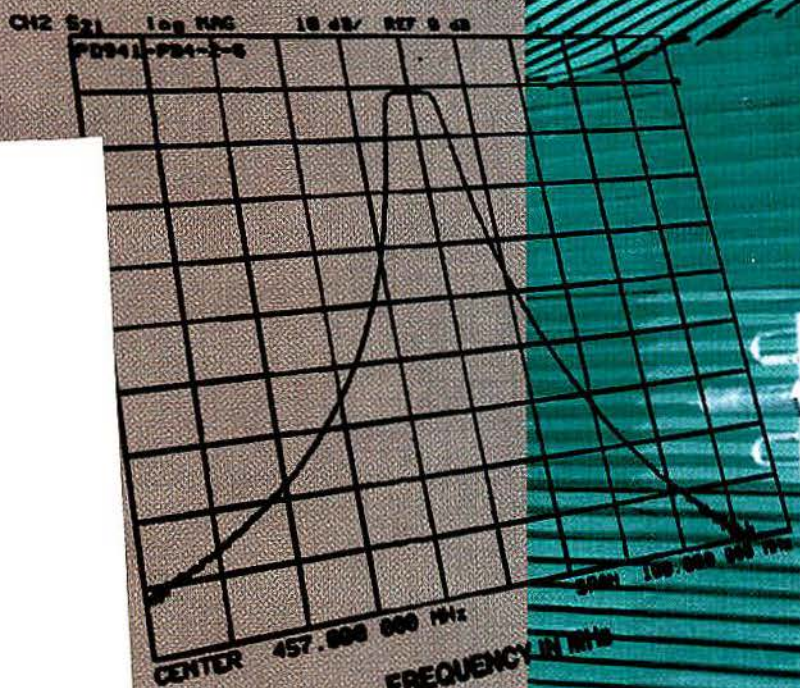
Technical information for private, trunked and public safety networks.

MARCH 2000



OIL SPILL RESPONSE COMMUNICATIONS

IWCE PREVIEW



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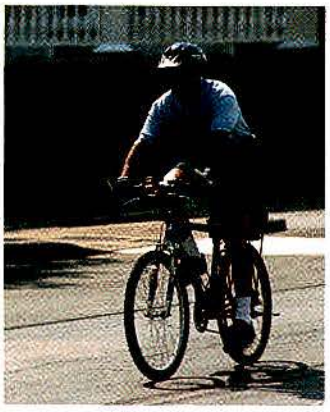
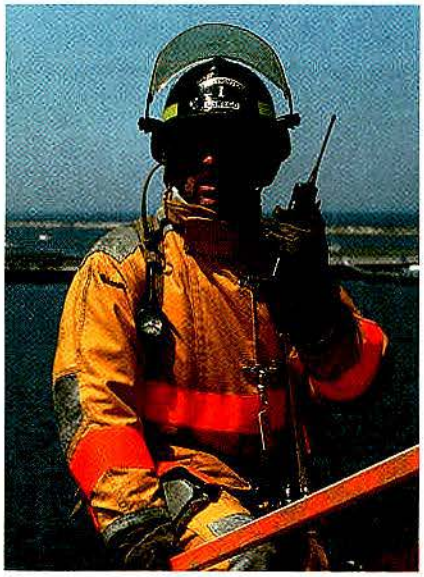
trusts E.F. Johnson for their **communications system.**



The Oswego Police Bike Patrol works the downtown business district and city parks, often handling calls where regular patrol cars can't go.

THE SYSTEM AT A GLANCE

- **Simulcast 800 MHz Multi-Net® II system with six repeater sites and 10 channels.**
- **The radio system brings together all police and fire departments in the county, including 32 volunteer fire departments. County services and public works also use the system. There are 120 talkgroups and nearly 1,600 subscriber radios.**



For firefighters throughout Oswego County, the radio system eliminates the walked-on conversations and signal skip that plagued the county's old low-band radios.

Oswego County's radio system helps the Sheriff's Department coordinate with police, fire, and EMS departments in mutual-aid situations.

Oswego County's public safety communications center has 10 dispatcher/9-1-1 calltaker positions. The center handles calls for all public safety departments in the county.

Oswego Fire's water rescue and dive teams work with the Sheriff's Department and U.S. Coast Guard to keep area waters fun and safe for the area's many vacationers.

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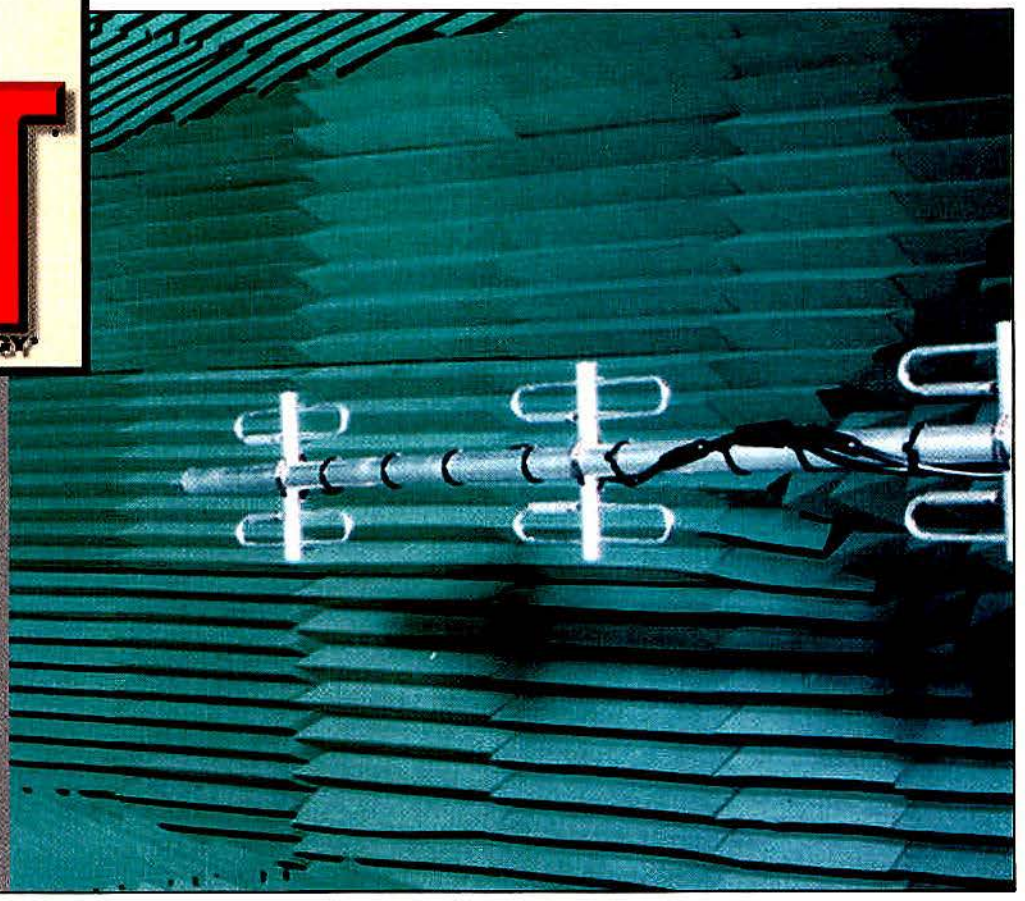
March 2000



On the cover: Performance testing on an antenna in an anechoic chamber. Does public safety need separate antenna standards? See the story on page 62. *Cover design by Scott Dolash, art director. Photograph courtesy of Cushcraft.*

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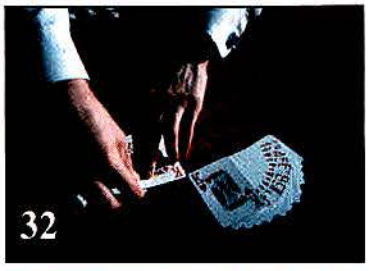

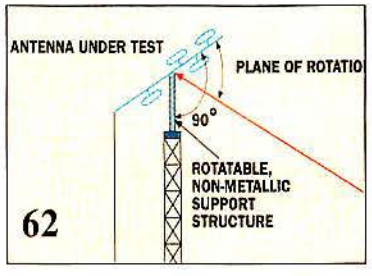

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Use the pull-out map and exhibitor list as a symposia guide. Refer to the exhibitors' product/services listings for information on what will be on display at the show.

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Donald E. Koehler
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62 Public Safety: Probing public safety antenna standards
D.A. Keckler
A technical standard is available to aid law enforcement agencies in procuring and using communications antennas.

66 SCADA lives!
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Public safety radio

Money. Public safety radio communications. How and when the two come together have much to do with implementing new systems.

Some cities and counties go it alone. Others form alliances with one another for combined systems. Forming alliances take time. Not all of the participants may need upgrades *and* have funding at the same time. When such a plan comes together for a combined system, economies are gained.

How often do large cities substantially upgrade their radio communications systems? Every 10 or 15 years, at best. For some, it may be as long as 30 years. Mention the 700MHz band in connection with upgrading public safety radio systems and you'll find some agencies are counting on it, some are merely hopeful and some find the idea laughable—meaning unaffordable. Money—how to get it, how much is available, and when—has a lot to do with various agencies' perspectives on the new band.

Some agencies missed out on 800MHz National Public Safety Planning Advisory Committee (NPSPAC) frequencies because by the time their funding was available and their governments gave approval to apply, frequencies in their area were taken. One example is San Mateo County, CA. You can read on our Web site some details about how the county found other frequencies. (See "FCC Diverts Paging Control Channels for San Mateo Public Safety System" at **www.mrtmag.com/editorial/news.htm**.)

San Mateo's timing was too late for NPSPAC and too early for the 700MHz frequencies being planned by the FCC's National Coordinating Committee (NCC).

Despite progress with standards and interoperability features that are expected to bring greater competition, and with it, lower prices, some agencies still complain that public safety handsets and base stations are unreasonably priced. High prices can limit upgrades to long cycles, too.

For fire departments, where as many as 80% of firefighters are volunteers who buy their own equipment, price is a *big* consideration. It means simple and conventional radio equipment. If and when it comes to system upgrades, many fire departments will look at VHF highband and frequencies transferred from federal government use to commercial, state and local use under the FCC's administration. NPSPAC and NCC frequencies won't get a glance. Right?

That being said, keep an eye on the Pennsylvania Public Safety Radio Project. (See "Up and Out in Pennsylvania" in the February issue of *Mobile*

Radio Technology, and the project's Web site at **www.radio.state.pa.us**).

The project represents a big step toward the "de-radioing" of wireless communications networks, as the computer component of any radio communications device and network grows larger and larger. The project uses off-the-shelf components for almost everything but the digital-to-analog conversion. With the use of a wide-area computer network to support statewide radio coverage, it becomes possible to buy routers, servers and hubs from highly competitive computer suppliers. Suddenly, the radio network takes on the same guise as a radio itself—a microcomputer with RF laid on top. RF manufacturing is no longer such a big deal.

Besides that, there's the notion that more and more jurisdictions will rely on outsourcing the entire radio communications function. That's part of what Com-Net bets as it absorbs Ericsson Private Radio Systems and advances its business model to finance, construct, administer and maintain entire radio systems to serve agencies that will contract for airtime. Com-Net's going to need a lot of money to carry out its plan. In effect, it will be a surrogate for the city, county and state governments, shouldering a massive financial burden during the radio system's life cycle. What may make the idea attractive to governments—and successful for Com-Net—is the shift by the governments from a capital expenditure to an operating expense. That would seem easier for council members, commissioners and legislators to approve. It may give Com-Net an advantage, and it may deliver upgrades to public safety agencies on shorter cycles.

Nextel-NextWave saga

Because last month we updated Nextel's pursuit of frequencies licensed to NextWave, it's worth mentioning that a federal court has rejected the FCC's move to cancel NextWave's licenses, a move that would have made them available for reauction. How's this? The judge called the FCC's action "self-help repossession by ambush."

Part of the problem is that attorneys speaking for the FCC in various times and places have made inconsistent statements. Maybe they haven't had time to check with one another, or maybe they've changed their minds. Whatever the case, sometimes they've said NextWave owned the licenses, so they could be sold to another company. (Guess who?) In backing up the action to cancel the licenses, they've said that NextWave never owned them because it defaulted on payment, an omission that "automatically" cancels a license.

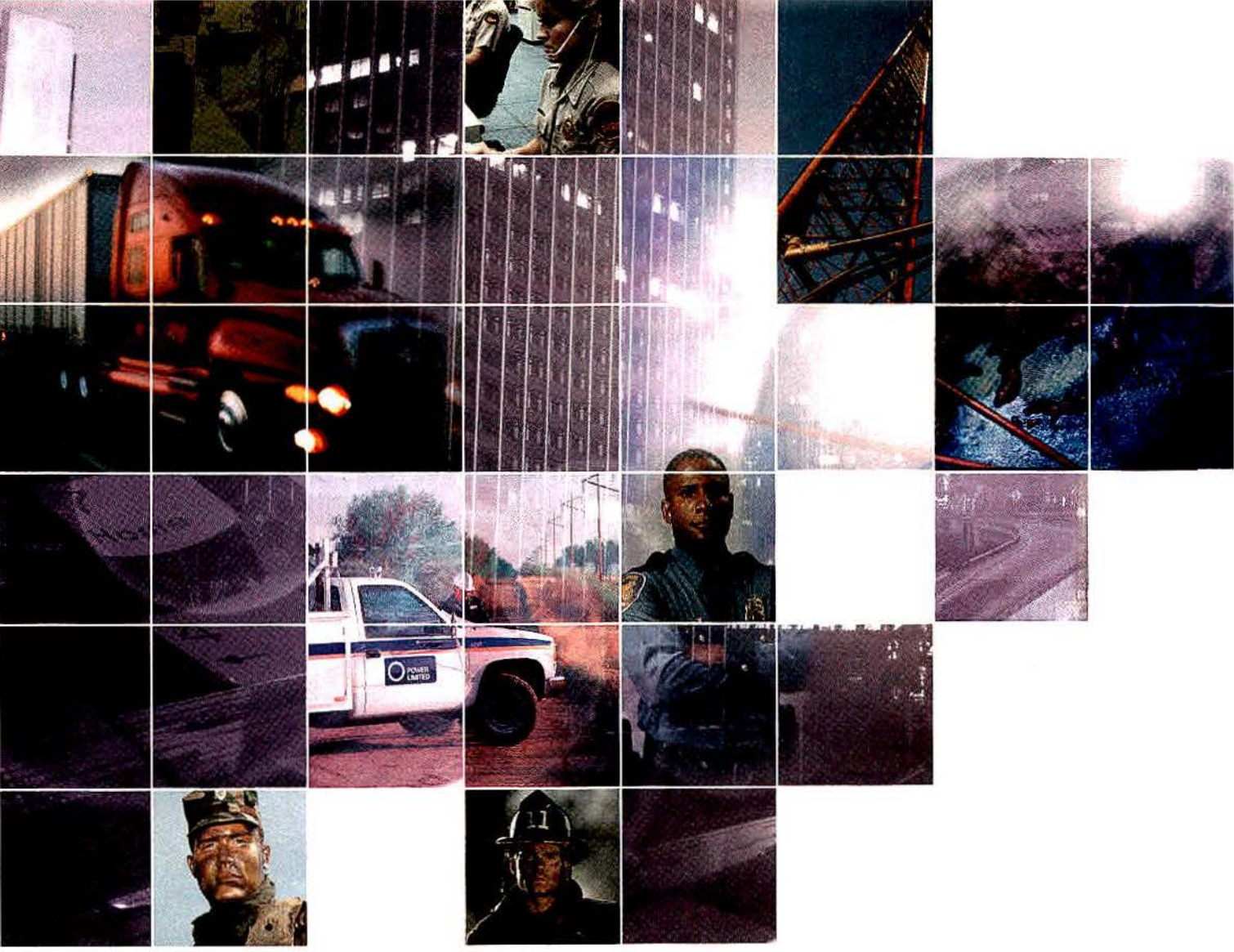
Radioburgers

Already one of the large users of business radio in the United States (those wireless mics used at the drive-up window are on VHF highband channels), McDonalds restaurants are taking a step toward using radio for automatic billing, too.

Using the same technology that bills motorists automatically for tolls on highways, five restaurants in Santa Ana, CA, will bill drive-through customers for food purchases. It's expected to cut 15 seconds off of an average 131-second wait. I guess that adds up.

don_bishop@intertec.com

Don Bishop



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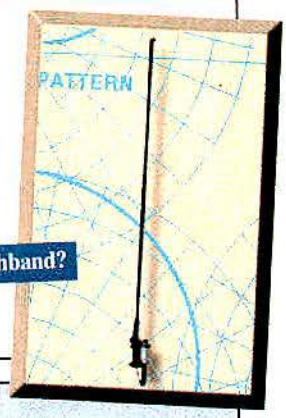
NEXT MONTH—APRIL 2000

FEATURES: VHF highband; Wireless@work—what's up at UPS?; Public safety mobile computing.

PLUS: Robert H. Schwaninger Jr.'s "In the Public Interest"; Harold Kinley's "Technically Speaking"; David Dunford's "Public Safety: 10-2"; editorial commentary from Don Bishop and Nikki Chandler; Product focus—what's new in surge protectors.

AND IN THE MONTHS TO COME:

800MHz conventional systems; base station antennas; filters; power supplies; interconnection; APCO pre-show; portable radios.



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CALENDAR

2000

March

6–8: APCO Western States Regional, sponsored by the Association of Public-Safety Communications Officials–International, Doubletree Hotel Portland, Portland, OR. Contact: RoxAnn Brown, 503-690-4911 ext. 206 or Web site **www.apcointl.org.**

19–22: ENTELEC, sponsored by ENTELEC, Dallas Convention Center, Dallas. Contact: 281-357-8700 or Web site **www.entelec.org.**

22–24: International Wireless Communications Expo, co-sponsored by *Mobile Radio Technology*, Las Vegas Convention Center, Las Vegas. Contact: 800-288-8606 or **www.iwceconexpo.com.**

April

10–12: APCO North Central Regional, sponsored by the Association of Public-Safety Communications Officials–International, Holiday Inn, Worthington, OH. Contact: Jay Somerville, 614-761-6530 or Web site **www.apcointl.org.**

May

8–11: Telecommunications Resellers Association Spring Conference and Exposition, Philadelphia Marriott. Contact: 202-835-9898 or Web site **www.tra.org.**

15–18: Spring Vehicular Technology Conference, sponsored by IEEE Vehicular Technology Society, Hotel Pacific Tokyo, Tokyo. Contact: 81-468-40-3552 or email **matumoto@mars.yrp.nttdocomo.co.jp.**

17–19: Site Owners & Managers Alliance (SOMA) Conference, sponsored by the Personal Communications Industry Association, Kansas City, MO. Web site **www.pcia.com.**

30–June 1: Canadian Wireless, sponsored by the Canadian Wireless Telecommunications Association, Toronto. Contact: 613-233-4888, ext. 102, or Web site **www.cwta.ca.**

June

4–8: Supercomm, sponsored by TIA and USTA, Georgia World Congress Center, Atlanta. Contact: 800-278-7372.

12–13: AMTA Leadership Conference and Annual Meeting, sponsored by the American Mobile Telecommunications Association, Sheraton Suites, Alexandria, VA. Contact: 202-331-7773 or Web site **www.amtausa.org.**

25–29: UTC Telecom, sponsored by UTC, The United Telecom Council, Phoenix. Contact: 202-857-1881 or Web site **www.utc.org.**

July

16–19: Forestry Conservation and Communications Association National Conference, Elms Resort & Spa, Excelsior Springs, MO. Contact: 573-751-4115, ext. 172.

August

13–17: Association of Public-Safety Communications Officials—International (APCO) National Conference, Boston. Contact: 904-322-2500 or Web site **www.apcointl.org.**

September

19–22: Fall Vehicular Technology Conference, sponsored by IEEE Vehicular Technology Society, Seaport Hotel, Boston. Contact: 904-322-2500.

26–29: Personal Communications Showcase, sponsored by PCIA, McCormick Place, Chicago. Contact: 703-739-0300 or **www.pcs00.com.**

November

12–15: Telecommunications Resellers Association Fall Conference and Exhibition, sponsored by TRA, Anaheim, CA. Contact: 202-835-9898 or Web site **www.tra.org.**

13–14: AMTEX, sponsored by the American Mobile Telecommunications Association, Ft. Lauderdale, FL. Contact: 202-331-7773 or Web site **www.amtausa.org.**

15–18: Communications Marketing Conference, sponsored by the Communication Marketing Association, Sheraton Colony Square, Atlanta. Contact: 404-892-2600, ext. 300 or Web site **www.commktga.com.**

2001

January

7–10: International CES, sponsored by the Consumer Electronics Manufacturers' Association; Las Vegas Convention Center, Las Vegas Hilton, Riviera Hotel and Alexis Park Hotel, Las Vegas. Web site: **www.CESweb.org.**

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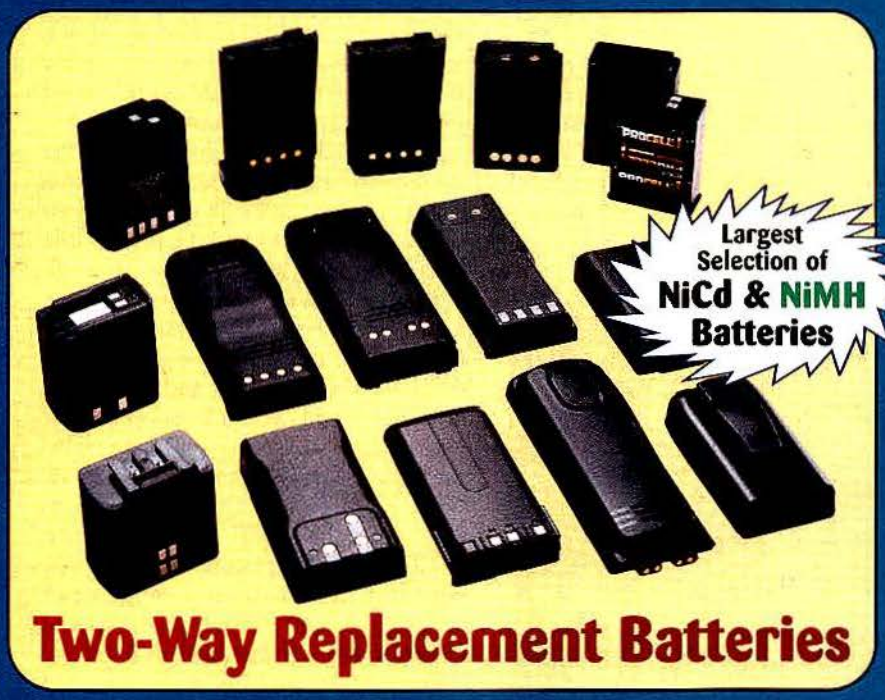

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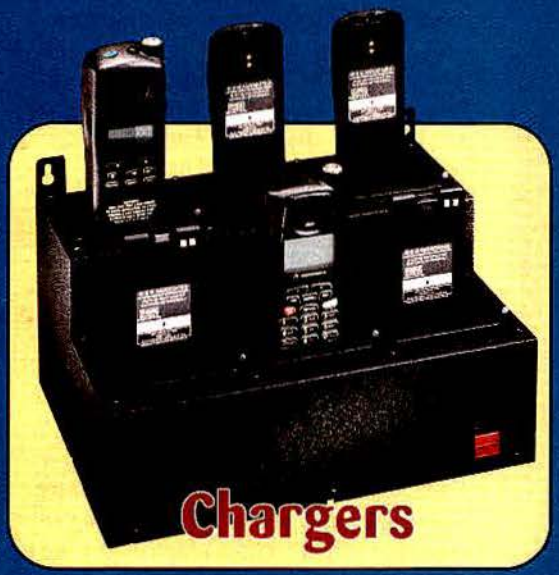

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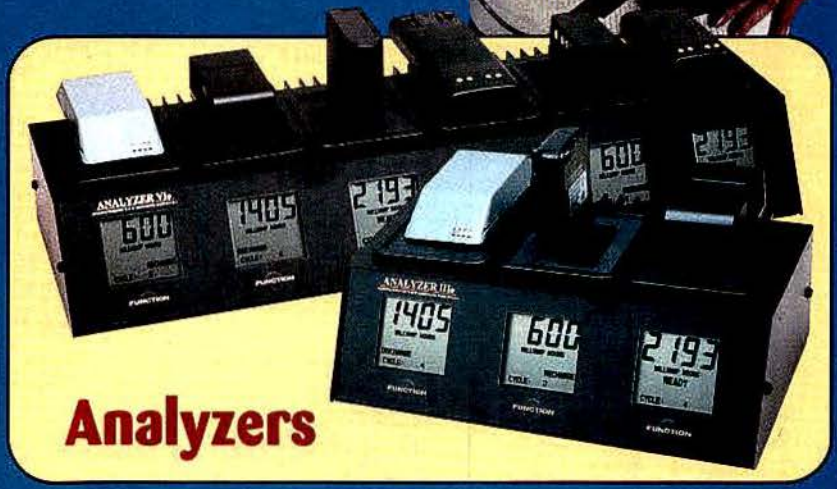

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Live from Las Vegas, it's IWCE!

Turkey at Thanksgiving ... a batch of homemade cookies for new neighbors ... champagne on New Year's Eve ... taking the "new guy" out for lunch on his first day. These are all great traditions—ones that we look forward to in our day-to-day lives. As for our business lives, this issue of *MRT* heralds one of our biggest industry—and staff—traditions: preparing for our annual trek to Las Vegas for the International Wireless Communications Expo, scheduled for March 22-24.

It wouldn't be spring without IWCE with all of its conference sessions, booths filled with friendly faces and new products, FCC roundtables and, most important, those after-hours hospitality gatherings. Add in the "cha-ching" of the one-armed bandits, the slap of the cards on the tables, the clink of ice against your cocktail glass and the glitz of the "Strip," and you've captured the entire "traditional" IWCE experience.

But, wait, there's more! In pure *MRT* and Intertec tradition, we continue to better serve our readers and our IWCE attendees. At this year's Vegas event, our editorial and marketing staffs are teaming with Intertec Exhibitions to launch "IWCE Live!"—a live Internet update—from the IWCE 2000 show floor. IWCE Live! will feature show reports, exhibitor information, general news coverage and after-hour, show-related activities that will be updated daily.

The on-line coverage will be hosted on the conference Web site at **www.iwceconexpo.com**, where prominent links will take the visitor to the magazine's site at **www.mrtmag.com**. The magazine's Web site will also prominently display a link to IWCE Live! Show attendees and exhibitors can browse the magazine and conference Web sites either in *MRT's* booth, where terminals will be set up, or at the IWCE Live! kiosk in the registration area. Attendees also will be able to request *MRT* subscriptions on-line.

As for more specific content detail in Las Vegas style, we've got big plans. We want to post your comments, thoughts and impressions. Don't be surprised if someone from our editorial team stops you to ask a few questions. While we're making personal visits to each booth, we also want to pick your brain to find out where the coolest product is, what types of issues you're facing and what suggestions you have for next year's IWCE.

If we don't come to you, stop by our booth (#249) and take a moment to visit our live site, and fill us in on your thoughts and ideas. We'll leave comment sheets for you to complete. Who knows? You could be the lead quote on tomorrow's update.

So pack your "lucky" show clothes, and get ready for your traditional spring trek to IWCE.

—Ramona Isbell
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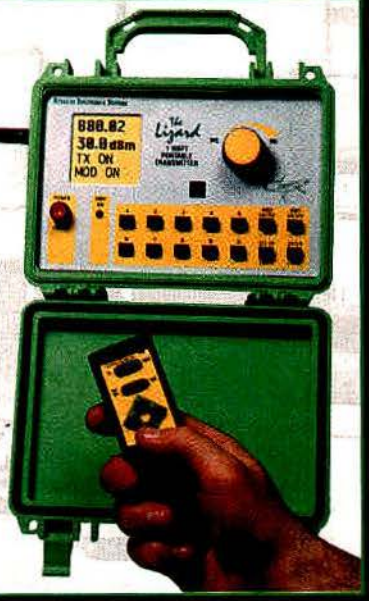

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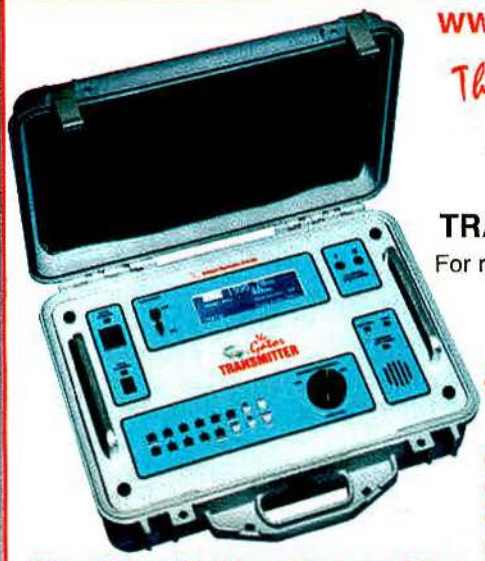

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Not for publication

By Robert H. Schwaninger Jr.

The other day I was flipping through a book of famous quotations that my wife got me for Christmas. I was trying to see if I was listed among the famous "sayers." I thought that maybe the editors might have lifted one of my bon mots from *MRT.* (That's right, I am delusional.)

As I was reading the pith and wisdom of Mencken, Woolcott, Locke, Aquinas and Buffalo Bob, it dawned on me that none of the FCC chairmen's names appeared. These guys speak all the time to gatherings of (allegedly) important people—like Congress. They're stars at events that shape the world of media and information. But, not *one* chairman has ever said anything profound enough quote for posterity.

Laws are like sausages. It's better not to see them being made.
—Otto von Bismarck

This struck me as a curious omission in the history of pith. Certainly, some FCC chairman has uttered words that are worthy of note. Perhaps the editors of books of quotations just hadn't recorded them. Maybe the problem is that the commissioners use speech writers and, therefore, their utterances do not qualify as original quotes. Are there rules to this game? I don't know. The more I thought about it, the more I wanted to know about the speech writers. I wanted to know what kind of person is penning the majestic phrases of our highest communications officials.

I checked the FCC telephone directory to see if anyone was listed in the position of speech writer, but no name appeared under the category. Now, I know that the commissioners don't write this stuff themselves. They're too busy with 3G, reciprocal compensation, WAPs, CDMA and other stuff that ordinary Americans assume refers to the secret ingredients in toilet cleansers.

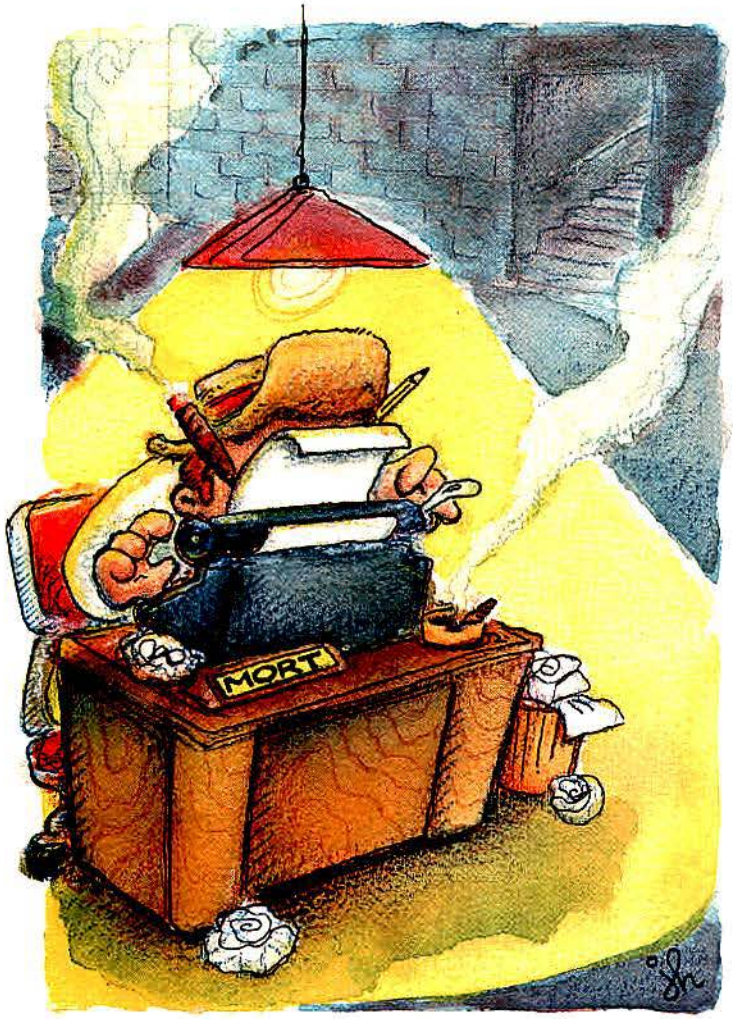

Illustration by John Hayes

It took four days, a small bribe and a look of pure confidence to search through the halls and floors of the FCC's new digs at the Portals. Eventually, I found "him" in a cubicle in the basement, banging away at a 40-year-old Remington typewriter, cursing the keys. Mort Stessel, the unofficial-official speech writer for the commissioners, glanced up and said, "Can't talk. Trying to come up with an opening joke for Kennard's speech at CTIA.

"Say, have you heard the one about the monkey, the lawyer and the local exchange carrier who were trapped in a refrigerator?" he asked in rapid-fire, clipped speech that hinted of a New Jersey childhood. "I can't remember if it's the monkey or the lawyer who sits in the butter."

Mort scowled at the typing paper with hooded eyes that were shadowed by a battered porkpie hat. A lock of limp, partially gray hair fell across his equally graying face, scrunched up in concentration. Suddenly, he rocked back in his cracked, green leather office chair and emitted a "Darn it!" that echoed off the concrete basement walls, where someone had taped a sign with faded block lettering: "IT'S *NOT* WHAT YOU SAY, IT'S WHETHER THEY *THOUGHT* YOU DID."

Ninety percent of the politicians give the other 10 percent a bad reputation.
—Henry Kissinger

Mort turned his tired, feral eyes on me and asked, "You here for the Sugrue speech? I told 'em I'd have it on Thursday."

"No, sir. I just wanted to meet the FCC's official wordsmith," I declared with a friendly smile. My attempt at cordiality netted me a snort from Stessel that also echoed off the cold walls.

"*Wordsmith?* Who are *you* kidding, kid? I've been banging this thing since Marconi was in Pampers, and I've never had to speak to a civilian. So why'd they send you to see me?"

"They didn't," I said. "I just wanted to meet you—learn about you."

"Why?" Mort asked suspiciously.

"Well, I figured that somebody had to be writing all of those speeches that the appointees deliver all over the place. I didn't know anything about you,

The only thing that saves us from the bureaucracy is its inefficiency.
—Eugene McCarthy

Schwaninger, *MRT's* regulatory consultant, is the principal in the law firm of Schwaninger & Associates, Washington, which is counsel to Small Business in Telecommunications. Schwaninger is also a member of the Radio Club of America.

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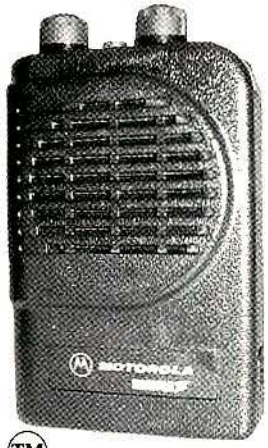

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so I 'looked you up,' so to speak."

"Yeah, I write 'em," he sighed. "And it isn't easy. You ever try to write a joke about *telecommunications*? It's not exactly the funniest subject on the planet. But, I've been coming up with them since 1971 when I was transferred from the common carrier microwave branch. I used to be a processor. The guy that used to do *this* job died right at this typewriter. Had half a page written for a speech in San Francisco. I've still got his opening joke around here. Not bad."

"Is it getting any easier?" I asked casually.

"Nope—harder. Now my stuff's got to be 'politically correct,' sensitive, give a sense of business savvy but never be controversial enough to upset anyone. Around the time of Fowler, the blue pencils really started working overtime. He wanted to send a 'message'—I just couldn't figure out what it was."

"How about Chairman Patrick?" I asked.

"The kid was always going on about the Fairness Doctrine, as if anyone outside of politics even knew what the hell it was. I told him to stick to cellular, but no-o-o-o. I'm just Mort, 'the Man in the Basement.' Whatta I know? So, he didn't get reappointed because he'd upset just about every sitting political big shot on Capitol Hill. I'm still here—he's history."

I am strongly in favor of common sense, common honesty and common decency. This makes me forever ineligible for any public office.

—H. L. Mencken

"How about Hundt?"

"Don't get me started. I was working nights and weekends trying to figure out how to spin the auction thing. I mean, selling *spectrum*? What's that? The stuff doesn't even exist! But this guy's out peddling this stuff to the rubes like snake oil. By the way, I caught hell for that 'federal cash cow' comment. It'd been a long weekend, and I guess I got a little nuts."

"Sounds like you don't like the guys you work for," I said flatly.

It takes a special breed to be an FCC chairman. Between the White House and Congress, you don't know if you're Charlie McCarthy or Edgar Bergen, but you know everyone's going to treat you like the dummy.

—Mort Stessel

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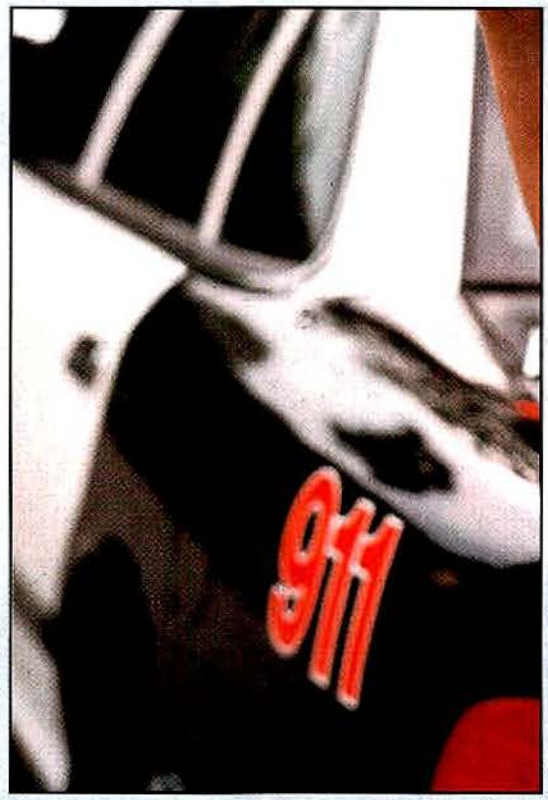
Cramming

Modern problems of the mobile equipment installer.

By David O. Dunford



Modern wireless phone providers are lucky. To them, "equipment installation" consists of delivering the new handset in a logo-laden, color-printed cardboard box. Many of you may remember when a "compact" mobile telephone consisted of a F.A.C.T.S. head and a TLD-1100 trunk unit with a connecting cable the diameter of a hot dog.

While users among the general public have fared well with miniaturized handsets and one-piece, two-way radios, public safety agencies have been burdened with an expanding inventory of electronic equipment aboard the typical fire apparatus or law enforcement sedan. The problem is well known by (and near to the heart of) every installer: How can we cram about a dozen different types of devices and systems into a neat-looking and ergonomically efficient package that will fit into the "air-bag friendly" space of a police-type sedan?

Although the auto manufacturer's drawing of the driver's compartment indicates a generous space for equipment layout, it really works out that the installer has some room on the floor (if allowed the luxury of bucket seats) and only a little room in front of the dash. (The allowed dash space is about the size of a shoe box after you step on it.) Here again, in the area of system integration and mobile equipment installation, public safety follows the technology curve that is led by consumer electronics. With the exception of the slowly emerging A.L.E.R.T. prototype cruisers (see **www.iacptechnology.org**), there hasn't been any significant push or agreement on industry standards for the installation of public safety mobile equipment. Fortunately, the size of the individual pieces of newer equipment is shrinking and is often less demanding on automotive electrical systems, which are becoming more robust. Fire apparatus manufacturers can provide a variety of console and compartment spaces. Currently, two automakers produce full- sized (more or less) cars to accommodate the myriad lights, brackets and antennas for law officers (and, eventually, cab drivers when the cruisers end up at a municipal auction).

Several major distributors of consumer-based mobile installation supplies have emerged, offering a wide variety of materials readily suitable for public safety equipment installations. Even with better, smaller equipment and readily available installation supplies, the main problem that still remains is the installer's time required to prepare the vehicle and equipment and then to complete the actual "cramming" process.

Our small department has wrestled with this problem for years and reached two conclusions. Neither axiom is particularly brilliant, but they are valid nonetheless:

1. Prewire as much as possible.
2. Spend as little time "in" the car as practical.

Our shop has one great luxury: We outfit all our of cars the same way. Large public safety agencies, as well as small commercial shop installers, often share the common problem of being tasked to install a different complement or layout of equipment in each vehicle. Making each car a custom installation requires even more shop time. Often, budget-limited customers don't understand (and don't want to pay for) the time it typically takes to change over a vehicle.

In an effort to pre-assemble and prewire equipment, we've begun routing almost all wiring to a common

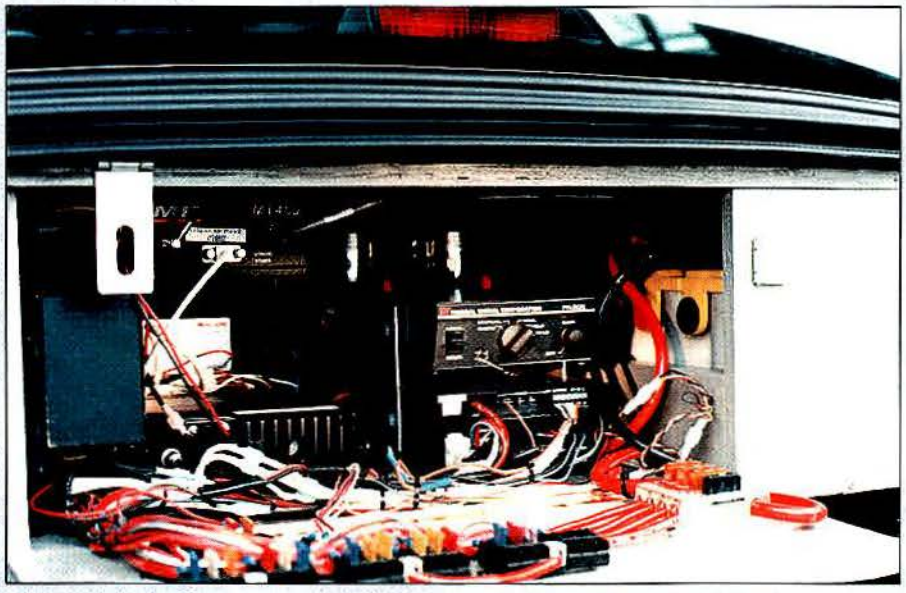


Photo 1. A common control box mounts in the roof of the police cruiser's trunk.

Dunford, MRT's public safety consultant, is manager of technical services for the Lenexa, KS, police department. He is a member and past-president of the Kansas Chapter of the Association of Public-Safety Communications Officials—International. You can email Dunford at **mrt@intertec.com.**

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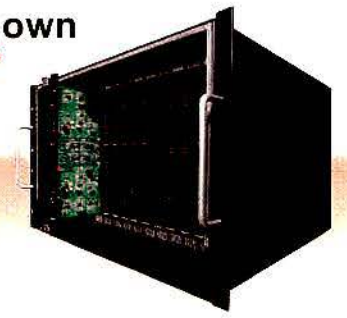

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Photo 2. The equipment console is mounted between the front seats in fire apparatus.

control box mounted in the car trunk. We chose the trunk over the engine compartment because of the adverse effect on fuses and circuit breakers from the elevated under-hood temperatures. Photo 1 on page 16 shows the trunk equipment box of a typical police cruiser. This is our "version 3.0" of an idea started back in 1975. Then, prewiring consisted of simply mounting a few circuit breakers, the radio A+ fuse and a contactor onto a piece of plywood that was screwed to the left front inner fender. With the new assembly, connection to all the car wiring is via two plastic AMP plugs on the back of the box. Circuitry on the left wall of the box is for light flashing and lamp cutout. The compartment on the right of the box houses an isolated second battery to provide power to the emergency equipment and radios separate from, but charged by, the vehicle system. The mobile data Bell South Wireless radio modem is mounted on the box lid and the remote-head Maxtrac two-way radio is mounted on the box floor. Photo 2 at the left shows the equipment console of a Lenexa Fire Department Unit 922. Through the specification and purchase process, Division Chief David Kuntz has evolved this console device so that all vehicles bought in the recent years have a readily accessible place to mount the control units or radio units.

Even after the pre-wiring is completed, extensive installer time is required "in" the driver's compartment to physically mount and then electrically connect all the various equipment (more on that next month).

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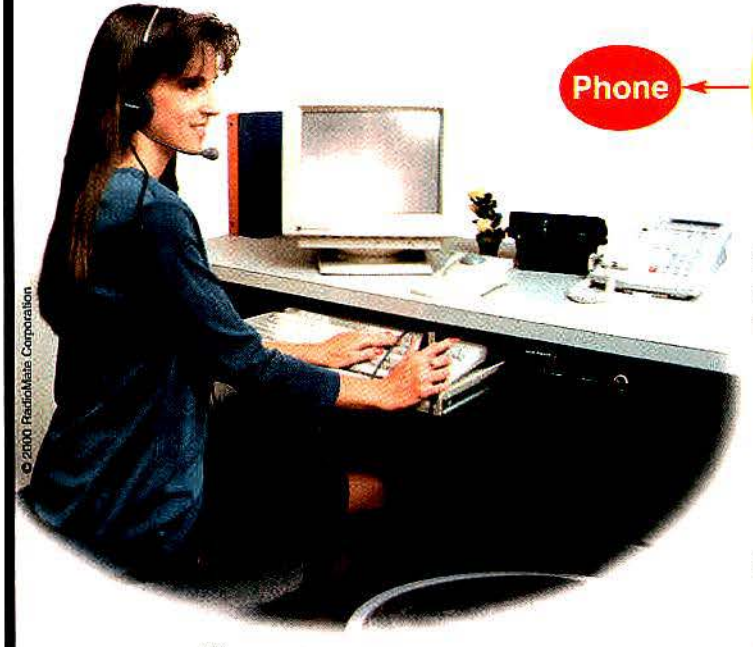

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winSMITH: A computerized Smith chart

By Harold Kinley

The Smith chart is not used by land mobile radio technicians in performing their routine duties. However, understanding transmission lines and impedance matching *is* valuable to all who work with radio frequency equipment. The use of the *win*SMITH computerized Smith chart provides an excellent insight into transmission lines and matching networks. A few examples will serve to illustrate just how useful this tool can be. (Sourcing is given at the end.)

Figure 1 below is a screen snapshot of the *win*SMITH computer program. Here, a pi matching network is used to match a load consisting of a series resistor of 120Ω and an inductive reactance of 37Ω (120 + *j*37) to 50Ω.

Navigating in the program

First, a few notes about the screen snapshot. All of the available components are shown as buttons on the tool bar. In the *insert* mode, you can place a component on the schematic by simply clicking on the desired component button on the tool bar. In the insert mode, the new component will be placed just to the left of the selected component. The selected component is the one in the boxed area. If the program is not in the insert mode, the selected component will be replaced with the desired new component.

The value of the selected component is shown in the box just below the schematic. In Figure 1, the selected component is C_1. The values of the components are: C_1 = 25pF, L_1 = 50nH and C_2 = 25pF. The dotted circle around the center of the chart represents the constant VSWR circle. This feature can be turned on or off as desired. This VSWR circle is set to a VSWR of 1.5:1. (It can be set to any desired value.) On the chart, the "X" represents the impedance at the load (output of the circuit at the right) and the "O" represents the impedance at the input to the circuit at the left. If the "O" is highlighted with the mouse pointer, the "O" and the connecting arc will turn yellow, and several parameters will be listed in the top right corner of the screen.

These parameters are: *Z* (complex impedance), *Y* (complex admittance), *S* (*S*-parameter, S_{11}, or return loss in decibels and the reflection angle), *G* (gamma, or reflection coefficient and reflection angle), *V* (VSWR) and *F* (frequency). As shown, the VSWR is almost 3:1, and so the pi network must be tuned to place the "O" directly over the center (origin) of the Smith chart. Once the circle is placed over the origin of the Smith chart, the input impedance to the pi network will be 50Ω. This is the reference impedance shown under "Terminations" at the left of the screen. Stated another

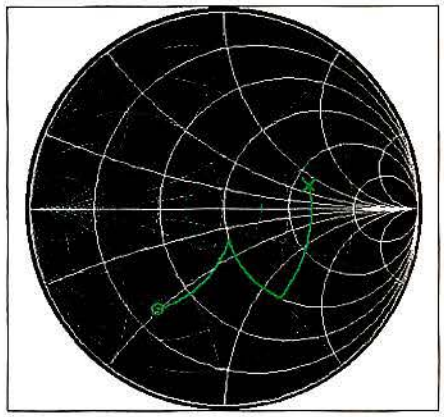

Figure 2. Capacitor C_2 is selected and tuned down to about 12.8pF. This causes the arc representing the inductor, L_1, to fall on the 50Ω constant resistance circle. *See text.*

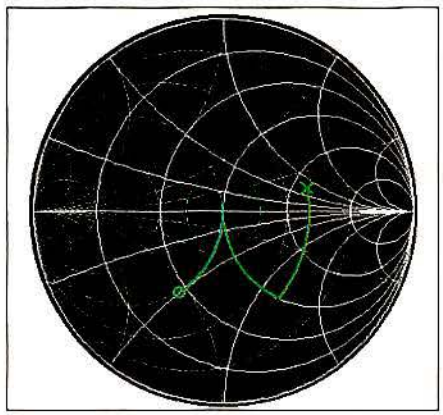

Figure 3. Inductor L_1 is selected and tuned to about 71.7nH so that the arc just passes through the origin of the Smith chart. *See text .*

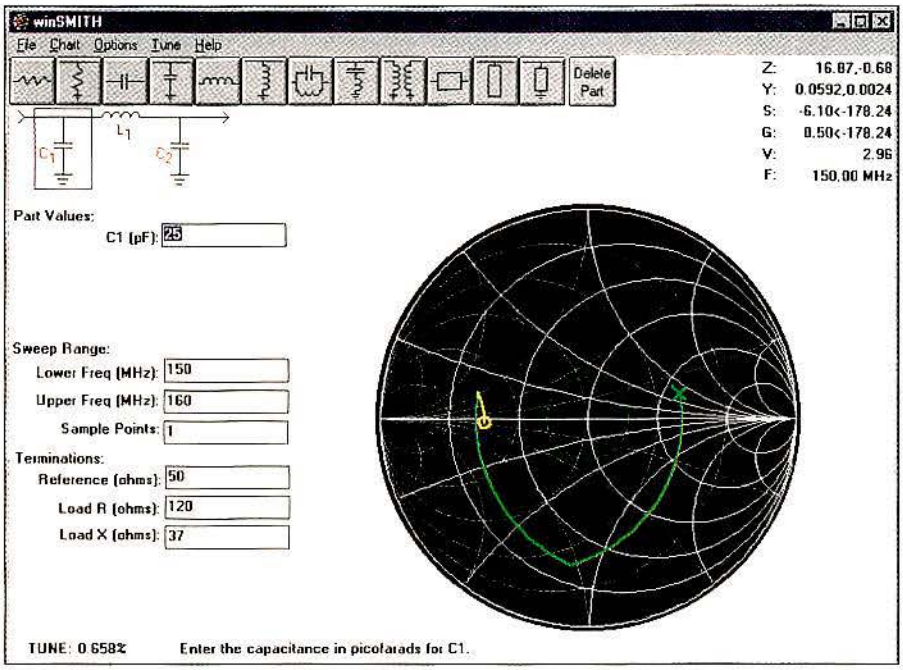

Figure 1. A screenshot of *win*SMITH 2.0 computerized Smith chart program. Here, a pi impedance-matching network is used to match an impedance of 120 + *j*37Ω to a 50Ω system impedance. The "X" marks the location of the load impedance on the chart, while the impedance at the input to the pi network (on the left of the circuit) is denoted by the "O" highlighted in yellow. At this point, the values for the pi network are: C_1 = 25pF, L_1 = 50nH and C_2 = 25pF. *See text for more details.*

Contributing Editor Kinley, *MRT's* technical consultant and a certified electronics technician, is regional communications manager, South Carolina Forestry Commission, Spartanburg, SC. He is the author of *Standard Radio Communications Manual, with Instrumentation and Testing Techniques*, which is available for direct purchase. Write to 204 Tanglewylde Drive, Spartanburg, SC 29301.

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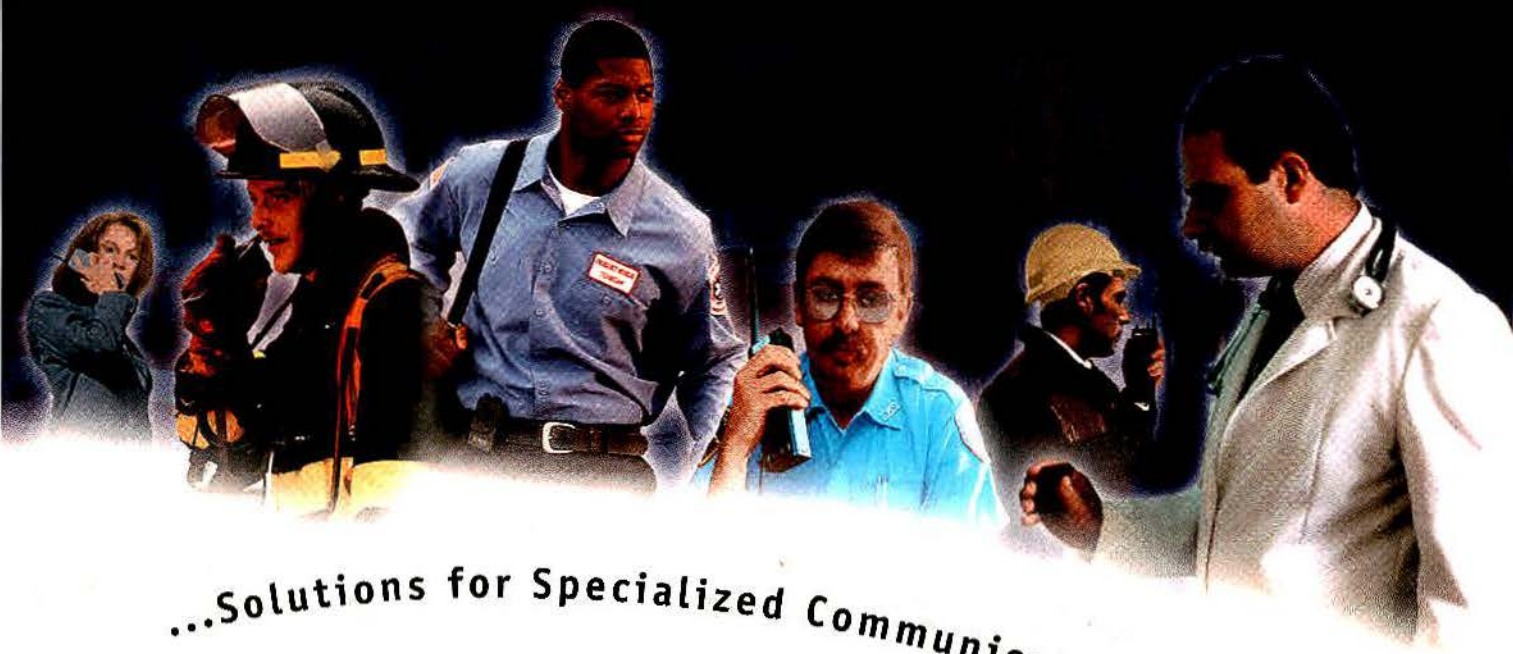

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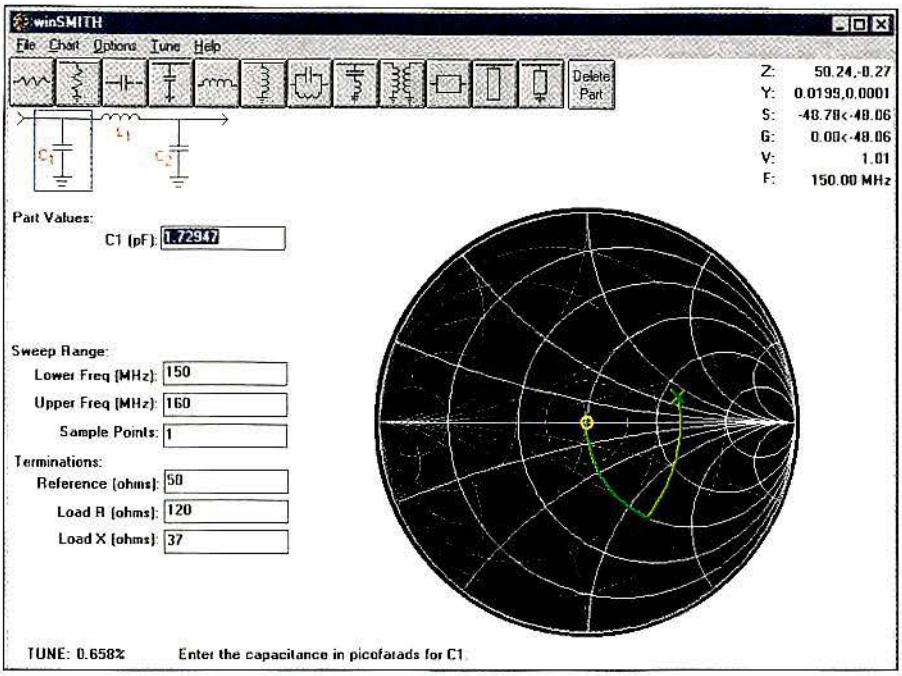

Figure 4. Capacitor C_1 is selected and tuned to about 1.7pF so that the "O" is positioned directly over the origin of the Smith chart. As shown in the upper right corner, the impedance at the input to the matching network is now $50.24 - j0.27\Omega$. This is a close match to the 50Ω system impedance, with just a fraction of capacitive reactance. The VSWR at this point is 1.01:1, a good match indeed.

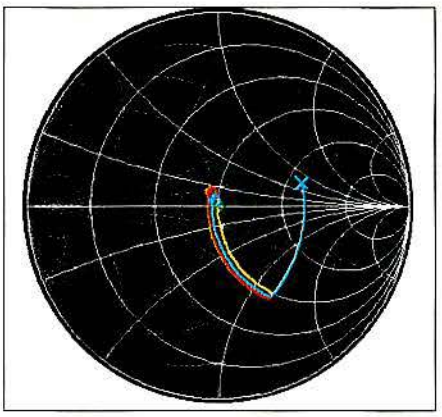

Figure 5. Here, three plots are shown to cover the frequency range of 150MHz to 160MHz. One plot is for 150MHz, one is for 155MHz and another is for 160MHz. As shown, all of these plots fall well within the 1.5:1 VSWR circle, and thus the matching network would effect a good impedance match at all of these frequencies.

way, the input impedance will be equal to the reference impedance when the circle is positioned directly over the origin of the Smith chart. The reference impedance can be set to other values of system impedance as well.

Note that the sweep range can be set from a minimum frequency to a maximum frequency with a number of sample points set by the user. If three sample points are specified, then the minimum frequency, maximum frequency and a center frequency would be plotted on the Smith chart. As shown on the screen, the sweep range is from 150MHz to 160MHz with only one sample point at this time. Because only one sample point is

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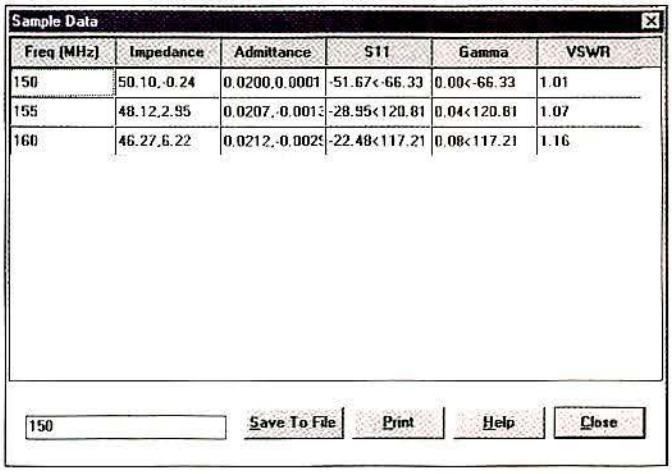
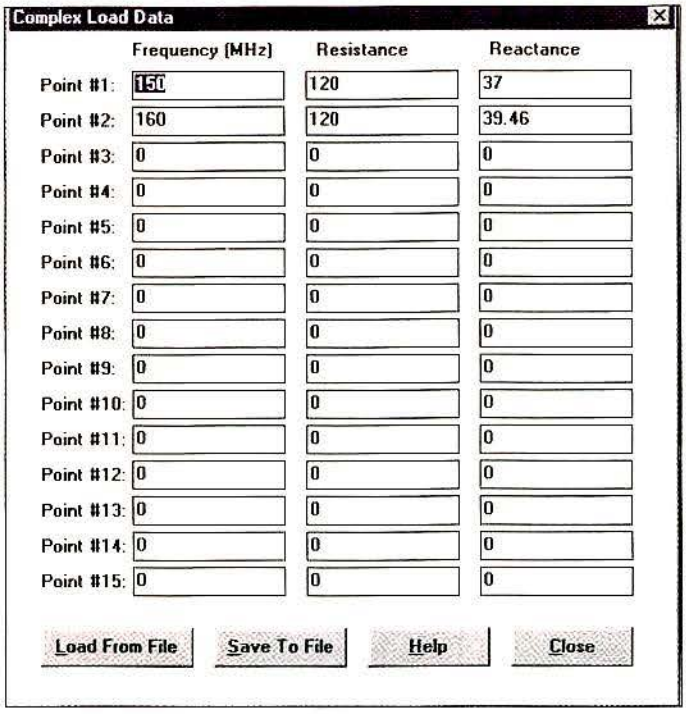


Figure 6. (Above) By selecting the OPTIONS menu and then VIEW CALCULATED DATA, this chart is brought up on the screen. This chart lists the various parameters at all the plotted frequencies.

Figure 7. (Right) Instead of using a single load impedance at all of the frequencies of interest, you can specify a separate load impedance at each plotted frequency. Selecting VIEW LOAD TERMINATION DATA under the OPTIONS menu allows a different load impedance to be entered for each frequency to be plotted. To activate this, simply select USE LOAD TERMINATION DATA under the OPTIONS menu. *See text.*



specified, it will be 150MHz.

First, we will work to get the circle over the origin of the Smith chart at 150MHz. Notice the three connected arcs on the Smith chart. Each of these arcs represent one of the components of the pi network. The arc connected to the "X" represents the capacitance, C_2. The center arc represents the inductor, L_1.

The final arc, connected to the circle, represents the capacitance, C_1.

So, to meet the objective of matching the load to 50Ω, we will have to tune the components in the pi network so that the circle is directly over the origin of the Smith chart. With *win*SMITH, it is possible to have either the admittance grid or the impedance grid turned on—or both. Notice that, in the example, we have both the admittance grid and the

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impedance grid turned on. It is helpful to see both the impedance and admittance grids to tune a network for proper impedance matching. The brightest grid is the impedance grid, while the dimmer grid is the admittance grid. Note that the impedance grid is composed of constant resistance circles and constant reactance arcs. Conversely, the admittance grid is composed of constant conductance circles and constant susceptance arcs.

To tune a component, we must first select it and, with the component box highlighted, press either the PAGE UP or the PAGE DOWN button to respectively increment or decrement the component value. To increase or decrease the *rate of change*, press F7 or F9 respectively. In this example, starting with C_2, we press the PAGE DOWN button until the capacitance is about 12.8pF. At this point (see Figure 2 on page 20), the arc representing the inductor (L_1) lies on the 50Ω constant resistance circle. Next, L_1 is selected, and the value is adjusted to about 71.7nH so that the arc just passes through the origin (see Figure 3 on page 20). Next, the input capacitor, C_1, is selected and adjusted until the circle is placed directly over the origin of the Smith chart (see Figure 4 on page 22). At this point, the capacitance of C_1 is about 1.7pF.

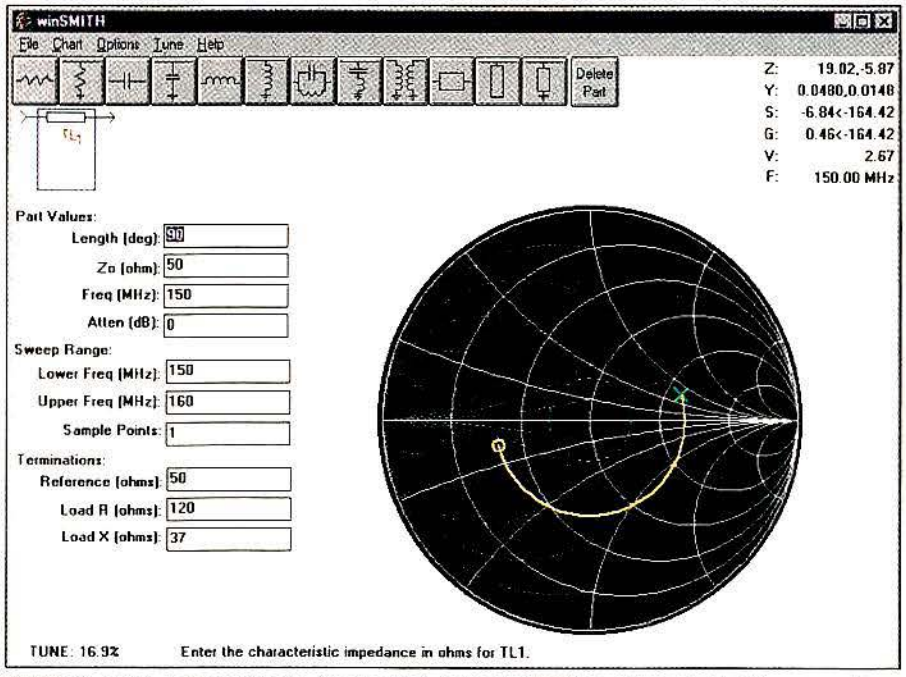
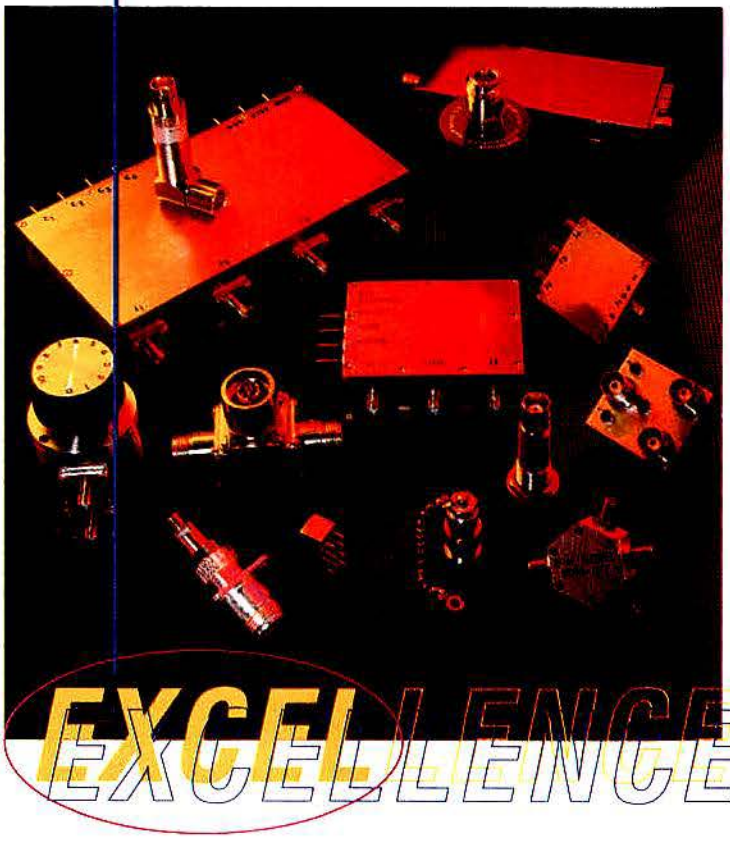


Figure 8. When a transmission line section is used (whether series or shunt), we must enter the length of the line, the characteristic impedance, the frequency of operation and the line loss. Here, a λ/4, or 90°, section of transmission line is connected to the load impedance (120 + *j*37Ω). The section of transmission line transforms the impedance from the "X" to the "O," representing one-half revolution around the Smith chart. The new impedance is shown in the upper right corner (19.02 – *j*5.87Ω).

Now, looking at the data in the upper right corner, we see that the impedance is 50.24 – j0.27, close to 50Ω, with just a small fraction of capacitive reactance.



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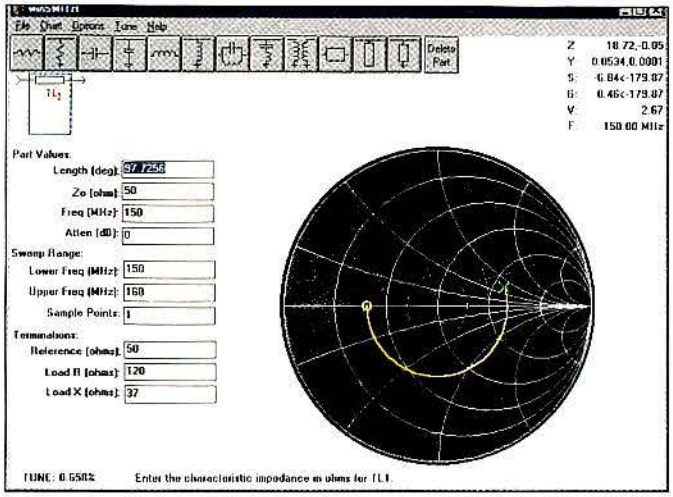

Figure 9. Here the transmission line of Figure 8 is lengthened until the circle is located on the horizontal (pure resistance) axis. As shown in the upper right corner, the impedance at this point is $18.72 - j0.05\Omega$. The reactive component is practically zero, leaving only a pure resistance. Thus, a reactive component can be tuned out by simply changing the length of the transmission line between the load and source.

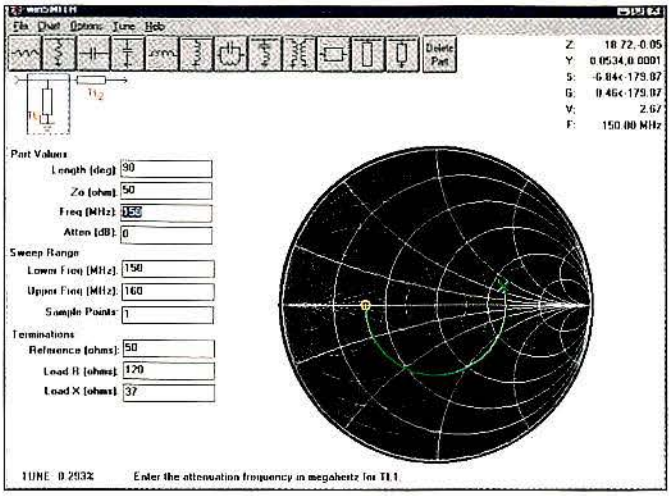

Figure 10. To effect an impedance match, a shorted stub is added to the input side of the series-connected transmission line. As shown, nothing on the Smith chart changed from Figure 9. When a new section of transmission line is added to the circuit, it is initially set to 90°, or $\lambda/4$. Because this stub is shorted on the far end, it reflects an open circuit at the end connected to the transmission line. Thus, the open circuit has no effect when connected across the line. If the length is changed from 90°, or $\lambda/4$, it will affect the impedance. *See Figure 11 below.*

Remember, this is at a frequency of 150MHz. If we want to know the response over the bandwidth of 150MHz to 160MHz, we can enter these figures into the sweep range and take three samples: lower, middle and upper frequencies. Figure 5 on page 21 shows just the Smith chart graphic for the three different frequency plots. Note that the input impedance of all three plots lies within the 1.5:1 VSWR circle. So, the resulting match at all frequencies would be quite acceptable. If necessary, the components of the pi network could be fine tuned to the center frequency to reach a compromise at the upper and lower frequencies.

By selecting the OPTIONS menu and then VIEW CALCULATED DATA, the chart in Figure 6 on page 24 is displayed. This chart lists the various parameters for each frequency. Another option from the OPTIONS menu is to USE LOAD TERMINATION DATA. Instead of using a single load impedance (resistive and reactive component) for all frequencies, a separate load impedance can be specified for each frequency to be plotted. Figure 7 on page 24 shows the table that is used to input the load impedance for each frequency to be plotted. This table can be viewed by selecting the OPTIONS menu and then VIEW LOAD TERMINATION DATA.

Let's look at another example using a transmission line to provide an impedance match. Using the same load impedance as specified in the first example ($120 + j37$), we will explore what happens when we use different lengths of transmission line. Then we will effect an impedance match using a transmission line stub placed at the proper point on the transmission line.

Refer to Figure 8 on page 26. Here, a $\lambda/4$, or 90°, section of transmission line is connected to the load. The arc on the Smith chart has moved halfway around the chart. Remember, $\lambda/2$ represents a full revolution around the Smith chart,

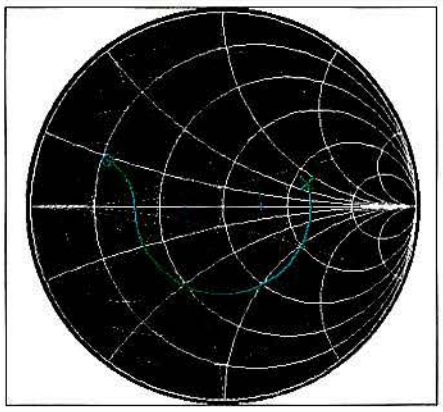

Figure 11. Here, the shorted transmission line stub shown in Figure 10 has been shortened to 24.6°. Notice the difference between this plot and the plot in Figure 10. The shorted stub now has affected the impedance, and the plot has changed.

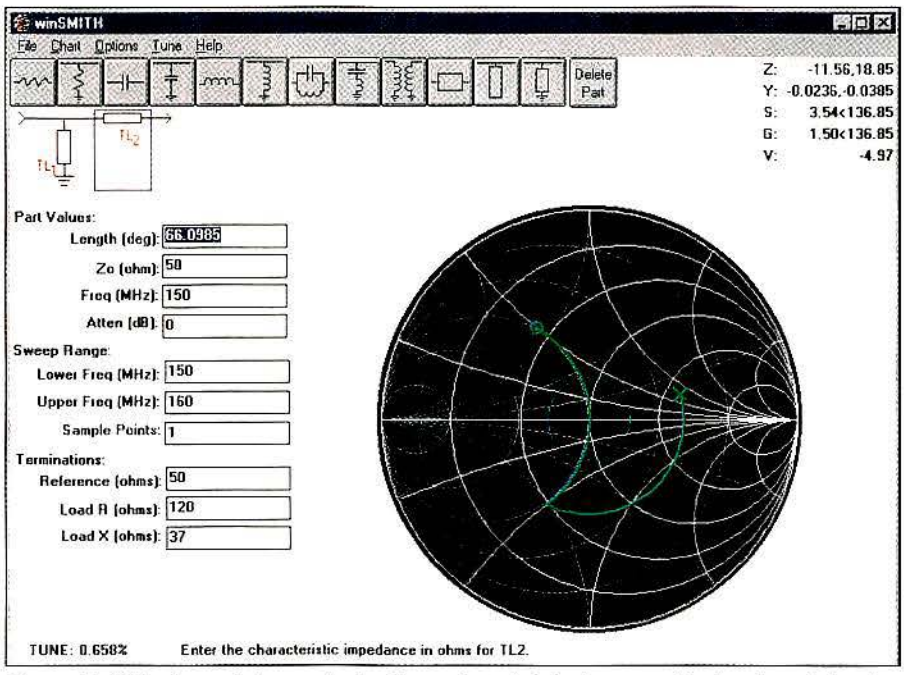

Figure 12. With the main transmission line selected, it is decreased in length to bring the arc representing the shorted stub to pass through the origin of the Smith chart. All that remains is to select the shorted stub and tune its length to place the circle directly over the origin of the chart. *See Figure 13 on page 29.*

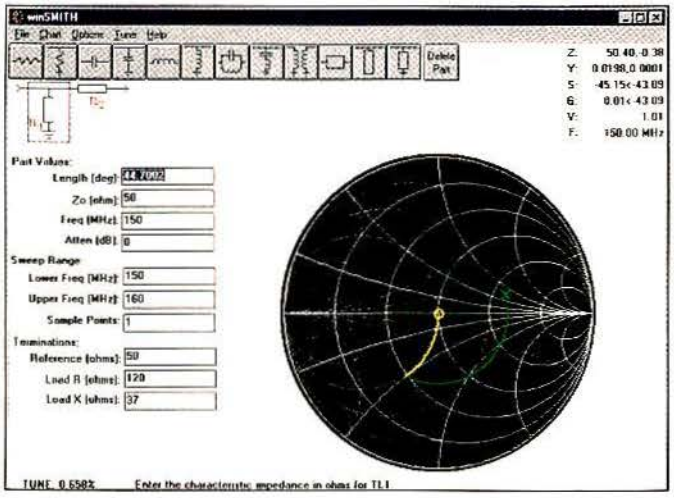

Figure 13. When the shorted stub is tuned to a length of 44.7° the circle is positioned directly over the origin of the chart and the impedance of the load is matched to the 50Ω system impedance. As shown in the upper right corner the impedance at the input is 50.4 – j0.38Ω, an excellent match.

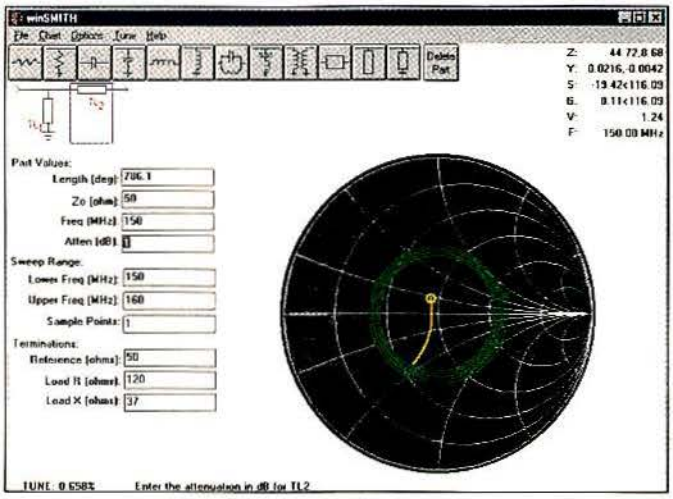

Figure 14. By adding two wavelengths to the main transmission line of Figure 13 and 1dB of loss the plot makes four complete revolutions around the Smith chart and the 1dB of transmission line attenuation has affected the impedance match. The circle is no longer centered over the origin. See text for details on how this can be handled.

and repeats for each additional λ/2. If we simply wanted to remove the reactive component from the load, we could lengthen the transmission line until the circle is positioned directly over the horizontal axis. Any point along the horizontal axis represents a pure resistance, no reactance. In Figure 9 on page 28, the transmission line has been lengthened to 97.6° so that the reactive component is removed and the input impedance is a pure resistance of about 18.7Ω. This still lies far outside the 1.5:1 VSWR circle, and so it isn't within our desired VSWR limit.

Let's add a shorted stub to the input side of the transmission line (see Figure 10 on page 28). A new transmission line (or stub) is always set to a length of 90°, or λ/4, initially. It is important to set all the transmission line parameters to the correct value. We are assuming a 50Ω line with no loss at a frequency of 150MHz. The λ/4 shorted stub has been connected to the input side of the transmission line—but nothing happened. The arc didn't change. This is because a λ/4 shorted transmission line will appear as an open circuit at the other end. So, the end connected to the input

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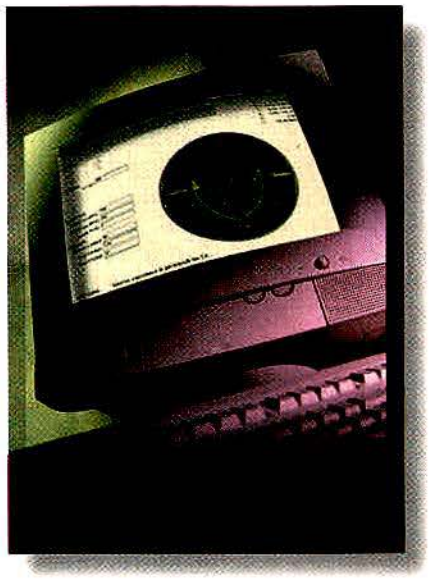
of the transmission line is open and has no effect on the impedance.

Now, let's change the length of the stub to see how it affects the input impedance. To change the stub length, we click on the stub (TL_1) and use the PAGE DOWN key to decrease the length while observing the arc. Figure 11 on page 28 shows the arc at a stub length of 24.6°. Next, we select the main transmission line and decrease its length until the arc connected to the circle passing through the origin on the Smith chart (see Figure 12 on page 28). Now, all we have to do is fine-tune the length of the stub until the circle is positioned directly over the origin on the Smith chart (see Figure 13 on page 29). Note that the impedance at this point is $50.4 - j0.38\Omega$—nearly a perfect match to a 50Ω system impedance.

You might note that the length of the main transmission line in the previous example ended up at only 66.1°. This is quite impractical in reality. Remember, the line can be increased to a more practical length as long as the added length is a multiple of $\lambda/2$, or 180°. You might also note that we used a theoretically lossless transmission line in our example. If you know the loss of the transmission line that you are using, you can enter it into the transmission line parameters.



Let's see what happens if we add 2λ (720°) to the main transmission line used in the last example. Let's also assume that the cable has a total loss of 1dB (see Figure 14 on page 29). You will notice here that there are four complete circles around the origin. For each $\lambda/2$ there will be one complete revolution around the Smith chart. Because there are four complete $\lambda/2$ sections, there will be four revolutions around the chart. Also, notice that the final impedance point does not end up over the origin of the chart. Thus, the attenuation of the transmission line has affected the impedance match. We don't know how long the cable is going to be until we have adjusted the lengths to place the circle over the origin on the chart. And if we then go back and calculate the attenuation of the cable, based on the final length the impedance at the input will change. How do we get around this? One simple way is to determine the practical length of cable needed to connect the generator to the load. Insert that line into the schematic on *win*SMITH. Enter the line length and loss and the operating frequency. Then add a second line in series with the first. Do not change the length of the first line—let it remain unchanged throughout the whole impedance-matching process. Let the loss of the second series line be zero. Because the line will be short, it won't exhibit much attenuation, and such a small loss will not significantly affect our impedance match. The loss in the stub can be ignored because it will be short and exhibit little attenuation. The loss that is entered for the series transmission line will be the *total loss* in the line—not loss per hundred feet as specified in transmission line charts, etc. The small series section of line that we are tuning will not exceed $\lambda/2$ and the stub will not exceed $\lambda/4$, so the resulting attenuation of each line will not be significant.

The *win*SMITH computer program is capable of doing much more than we were able to show in the space limitations of this column. Many additional features exist that were not discussed. The program is an excellent educational tool as well as a practical tool. It is intuitive and easy to learn. It takes longer to describe the operations than it does to actually perform them. Some prior knowledge of the Smith chart is helpful but not absolutely necessary.

A companion video tape by Glenn Parker would be helpful to those who have no familiarity with the Smith chart but would like to learn.

The *win*SMITH 2.0 software is available from Noble Publishing, 4772 Stone Drive, Tucker, GA, 30084. Phone (770) 908-2320 or fax (770) 939-0157. You can visit their Web site at **www.noblepub.com** The cost of the program is $79 for version 2.0. Special pricing is available for upgrading from version 1.0.

Until next time—*stay tuned!* ■

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2000 Show Guide

The International Wireless Communications Expo comes early this year, but it is still expected to be as big as ever. On March 22, wireless industry decision-makers will gather in Las Vegas to learn about new technology and trends, and to exchange ideas and make new contacts. More than 10,000 professionals and 350-plus exhibiting companies will be found at the Las Vegas Convention Center. You'll see dealers, resellers, operators, commercial end-users, community repeater operators, base station operators, engineers and mobile communications managers. Manufacturers and distributors will showcase innovations in mobile radio, RF engineering, paging, cellular and PCS base stations, RCC, community repeater operations, SMR and public safety.

Higlights of the show include:

- **The IWCE 2000 Conference Program**: Four main conference tracks address hot topics in business, regulatory, technology and public safety areas of today's mobile communications.
- **New Public Safety Track:** IWCE is extending the educational program this year to include a track dedicated to public safety applications and issues in wireless communications. Sessions in this track are held Wednesday, March 22, and Thursday, March 23.
- **The *RF Design* Seminar Series**: Offering technical sessions and tutorials designed to present information vital to the engineering professional, this series keeps you in-the-know on the latest industry developments and strategies. Seminars take place Monday, March 20, through Wednesday, March 22.
- **Welcome and Keynote Address**: "In the Public Interest" columnist Robert Schwaninger discusses the state of the industry and the efforts to maintain a competitive environment for local operators. He promises to bring his wit and wile to this year's keynote address.
- **State-of-the-Industry Report:** Stephan Beckert of The Strategis Group will present an analysis on the competitive position of the SMR and private radio industries in light of growing competition from cellular carriers, ESMRs and mobile data service providers.

- **Industry Leaders Meet the Press**: A free-ranging press conference will feature representatives from the trade press, including *MRT* Features Editor David Keckler and Rikki Lee from *Wireless Week*. Industry leaders in attendance: Mark E. Crosby, ITA; Joe Hanna, APCO; Donald Vasek, PCIA; Lonnie Danchik, SBT; Alan Shark, IWTA and Paul Najarian, LMCC.
- **FCC Roundtable and Forum:** Hear the latest on FCC activities, and take the opportunity to question FCC staff members on important industry topics. Issues include the upcoming FCC auction schedule and telephone hotline support; FCC Internet initiatives and the outcome of Y2K issues; and the final implementation of the Universal Licensing Program. *MRT* Editorial Director Don Bishop will moderate.
- **Simulcast Update 2000:** Sponsored by Simulcast Solutions, this presentation features system integrators recapping simulcast projects. The presentation will be held from 8 a.m. to 10 a.m., March 23, at the Las Vegas Hilton.

This guide is designed to help you plan your time at the Las Vegas Convention Center. Sections include:

- a pull-out map on page 32A, including a list of exhibitors and booth numbers.
- a summary of exhibitors' products and services on display, beginning on page 34. Exhibitors listed include those who submitted information as of press time. Advertisers in this issue are highlighted in blue.

See you in Vegas.

Base station workshops

The Base Station Workshops return as a vital part of the comprehensive conference programming for IWCE 2000. This series forms a complete instructional program designed specifically for the needs of the base station technician and operator.

DSP techniques for digital base station design
Monday, March 20
9 a.m.–5 p.m.

This course will focus on the practical design and implementation issues when developing DSP-enabled base stations.

Fundamentals of radio communications
Tuesday, March 21
9 a.m.–5 p.m.

This course addresses the basic elements of radio communications as well as propagation and the base station operating environment.

Testing the base station RF subsystem
Wednesday, March 22
9 a.m.–5 p.m.

The most important job of the base station technician is to ensure that the network is working properly from the standpoint of its RF components, including receivers, transmitters, amplifiers, baseboard subsystems, transmission lines and antennas.

Maintaining and troubleshooting the transmission chain
Thursday, March 23
9 a.m.–12 p.m.

This course covers the transmission of RF energy from the transmitter to the antenna. It highlights the areas in which problems develop, how to spot them and describes remedial methods and the tools available to verify that the problems are resolved.

Understanding and maintaining the wired-to-wireless link
Friday, March 24
9 a.m.–12 p.m.

Maintenance of a base station does not end with the RF system. The interface between the base station and the wired telephone network, as well as the backhaul link to the central station, are equally important. This course provides an overview of these links, the parameters that must be monitored, problem areas, measurements and remedial measures.

IWCE 2000
Schedule-at-a-glance

Monday, March 20, 2000

8 a.m. Registration (*RF Design* Seminar Series and Base Station Workshops only)

9 a.m. Base Station Workshops (Session runs 9 a.m.–5 p.m.):
DSP Techniques for Digital Base Station Design

9 a.m. *RF Design* Seminar Series (Sessions run 9 a.m.–5 p.m.):
RF and Wireless Made Simple
Frequency Synthesis and Phase-locked Loop
Foundations of RF Hardware Design

Tuesday, March 21, 2000

8 a.m. Registration (*RF Design* Seminar Series and Base Station Workshops only)

8 a.m. PCIA University: Mobile Wireless Curriculum
(8 a.m.–5 p.m. at Alexis Park Hotel.)

9 a.m. *RF Design* Seminar Series (Sessions run 9 a.m.–5 p.m.):
Measuring the Wireless Transmission Spectrum
Digital Signal Processing, Part 1
Techniques for RF Hardware Design

9 a.m. Base Station Workshops:
(Session runs 8:00am–5:00pm)
Fundamentals of Radio Communications

12 p.m. General registration opens

1 p.m. Small Business in Telecommunications' Jam Session II
(Session runs 1 p.m.–5 p.m. at Alexis Park Hotel.)

Wednesday, March 22, 2000

8 a.m. Registration opens

8 a.m. PCIA University: Mobile Wireless Curriculum
(Session runs 8 a.m.–11 a.m. at Alexis Park Hotel.)

9 a.m. Welcome and keynote address

9:30 a.m. State-of-the-Industry Report

9 a.m.. Base Station Workshops (Session runs 9 a.m.–12 p.m.)
Testing the Base Station RF Subsystem

9 a.m. *RF Design* Seminar Series (Sessions run 9 a.m.–5 p.m.)
Antennas and Propagation for Wireless Communications
Digital Signal Processing, Part 2
RF Amplifier Design

10 a.m. Exhibits open (10 a.m.–5 p.m.)

1 p.m. Business Track—Wireless Data: What's the Potential for Wireless Carriers?
Technology Track—Using RF Distribution Products to Reduce Costs in Digital Mobile Telephone Networks
Regulatory Track—Toward 3000: Wireless in the New Millennia
Public Safety Track—Comparing Conventional and Trunked Land Mobile Radio Systems

1:30 p.m. Business Track—Selling Mobile Data
Technology Track—Implementing Fast Turn-around, High-capacity Packet Radio
Regulatory Track—New Mobile Wireless Spectrum Allocation: Where Will it Come From?
Public Safety Track—How to Extend Your Private and Public Safety Trunked Systems with New Tools and Technology to Guarantee 100% Coverage

2 p.m. Business Track—Mobile Communications: How to Make Your Fleet into a Cost-Efficient, JIT Solution
Technology Track—Digital Signal Processing Applied to Multiple Radio, Multiple Frequency Interoperability Systems
Regulatory Track—RFR Update
Public Safety Track—DC/MA Digital Trunking System Design and Implementation

3 p.m. Industry Leaders Meet the Press
(Session runs from 3 p.m.–5 p.m.)

Thursday, March 23, 2000

7:30 a.m. RCA Breakfast Meeting

8 a.m. Registration opens

9 a.m. Base Station Workshops (Session runs 9 a.m.–5 p.m.):
Maintaining and Troubleshooting the Transmission Chain

9 a.m. Business Track—The Global Wireless Education Consortium: Increasing Your Bottom Line by Increasing Quality in New Employees
Technology Track—Smart Antennas: What Difference Do They Make?
Regulatory Track—How to Establish a Business and Make Money in the Third-World Countries of Eastern Europe and Asia
Public Safety Track—Enhanced GPS for Public Safety Applications

9:30 a.m. Business Track—How to Become a Wireless Internet Service Provider
Technology Track—Internal Antennas: They're Finally Here, and They Work
Regulatory Track—New Business Opportunities and Challenges to Wireless Technology in Asian Developing Countries
Public Safety Track—Mobile Data for Public Safety

10 a.m. Exhibits Open (10 a.m.–5 p.m.)

10 a.m. Business Track—Wireless 2000: The End is Coming
Technology Track: Advantages of Internal Antenna Technology in Hand-held Products
Regulatory Track—800MHz/900MHz Mysteries Unraveled
Public Safety Track—Interoperability for Public Safety Communications

11 a.m. Business Roundtable—E-commerce: What's in it for You?
Technology Roundtable—Wide-area Dispatch Trunking Systems
Regulatory Roundtable—SMR Incumbent Relocation: Status Report

1:30 p.m. FCC Roundtable and Forum

3:30 p.m. Business Breakout Session—Interconnection Update
Technology Breakout Session—DSP: Is it the Answer to All Your Radio Design Challenges?
Regulatory Breakout Session—Planning for Your Financial Future: The Anatomy of Selling a Business

Friday, March 24, 2000

8 a.m. Registration opens
Base Station Workshops (Session runs 9 a.m.–12 p.m.):
Understanding and Maintaining the Wired-to-wireless Link

9 a.m. Business Track—The State of the Mobile Industry: Where We Have Gone
Technology Track—The Voice of the Network: Important Trends in Speech-based Resource Control
Regulatory Track—Beware! The End is Near

9:30 a.m. Business Track—Wireless Data: The Time is Now
Technology Track—Transient Overvoltage and Lightning Protection for Wireless Communications
Regulatory Track—FCC Enforcement Efforts

10 a.m. Exhibits open (10 a.m.–2 p.m.)

10 a.m. Business Track—Keeping Pace with the 21st Century
Technology Track—Applying Marcus Magic to Site RF Design and Interference Issues Beyond Y2K
Regulatory Track—Tower Zoning: Overcoming Obstacles

10:30 a.m. Business Track—Reducing Wirelss Construction Costs with Expert Systems
Regulatory Track—R and TTE Directive

Products, services

The following preview information was supplied by the exhibitors. Information for listings and booth numbers is accurate as of press time and is subject to change. See map page 32B for complete exhibitor list.

Adaptive Broadband **Booth 702**
Existing products
LEDR family of microwave radios.
New products
LEDR T1 interface; protected/redundant LEDR radios; LEDR network management system; LEDR spread-spectrum 2.4GHz radio.
Circle 201

Advanced Label & Tag **Booth 1156**
Existing products
Custom nameplates for pagers, radios, cellphones and other wireless equipment; warranty and tamper-proof labels; screen-printed metal and vinyl labels; label-printing systems.
New products
Datamax I class thermal transfer printer model DMX-I-4206.
Circle 202

Advanced Battery Systems **Booth 677**
Existing products
Batteries: OEM; communication; Sanyo; GP; PowerSonic. Battery analyzers: NiCd; NiMH; lithium; ion; sealed lead.
Circle 203 **See our ad on page 14**

AEA, a division of Tempo Research **Booth 1269**
Existing products
Tempo 3120 Step TDR 3120-5000; AEA VIA analyzer (impedance analyzer) 5013-5000; AEA 140-525 analyzer (SWR) 5006-5000; AEA Cellmate II (SWR) 5010-5000; AEA VIA Director software for Windows 95/98/2000 5013-1201.
New products
AEA Cellmate II 5010-5000.
Circle 204 **See our ad on page 38**

AF CommSupply **Booth 132**
Existing products
Wireless communications equipment from more than 65 manufacturers such as Andrew, Celwave, Decibel, ICT, Maxrad, Newmar, SDI, Times and PolyPhaser. Products include base station, mobile and portable antennas; cable, connectors and installation accessories; amplifiers, filters, duplexers, combiners and couplers; grounding components; power supplies, inverters and converters; tone remotes, encoders and decoders; towers and enclosures; bench and test equipment; cellular accessories.
New products
Wireless Communications Equipment Catalog.
Circle 205

Alexander Technologies **Booth 731**
Existing products
The Optimizer; the Cheetah; universal smart charger; replacement battery packs for Motorola, Kenwood, Ericsson and most of the leading radio manufacturers.
New products
The Millennium charger; replacement batteries for Ericsson Prism radios; replacement batteries for Motorola's XTS 3000 radios; replacement for Kenwood KNB-17A battery; replacement batteries for Motorola's HT750/1250 radios.
Circle 206

Amplifier Research **Booth 714**
Existing products
High-power, broadband RF amplifiers; related test accessories.
New products
"S" series amplifiers featuring linear, low-noise power output and frequency coverage from 0.8GHz to 4.2GHz.
Circle 207

Amrel Systems **Booth 678**
Existing products
Rocky II+ rugged mobile computing system; PEL series programmable electronic loads.
New products
Discovery Rugged Table +.
Circle 208

Anchor Graphics Marketing **Booth 875**
Existing products
Communication labels; bar codes; ID labels; all types of custom labels; tamper-evident labels.
Circle 209

Andrew **Booth 125**
Existing products
Heliax coaxial cable product line; cable prep tools for connector attachments; step-tuned connectors for elliptical waveguides; accessories; EXT towers for land mobile installations.
Circle 210 **See our ad on page 41**

Antenex **Booth 544**
Existing products
Phantom; DiscaDoo; GPS indoor multiversity antenna; portable, base, mobile, mounts.
New products
Indoor multiversity antenna (MIA 8063ST); GPSU15M; GPSDVHF; GPSDUHF; GPSD800; Grade Master YNT8967.5M; YE240015; GRO (Rubber Boot).
Circle 211

AVCOM of Virginia **Booth 1242**
Existing products
AVCOM portable spectrum analyzers models PSA-65C, PSA-37D, PSA-33A and PSA-75A; network and spectrum analyzer NSA-1000A; microwave spectrum analyzer model MSA-90A, analyzer display adapter ADA-10A.
Circle 212

Avtec **Booth 1045**
Existing products
DSPatch console systems-integrated radio/telephone with color LCD displays that feature paging, auto-dial, caller I.D., more than 2,000 ports, T1/E1, ISDN, PRI plus analog connectivity; DSPatch32 for smaller applications.
Circle 213

Barnett Engineering **Booth 1264**
Existing products
B1225 alarm reporting unit; B1235 radio site monitor; B1270 voice auto dialer; B1272 cellular alarm reporting unit; B1275 SPX-PLC alarm auto dialer.
New products
B1280 FLX site monitor/controller.
Circle 214.

BearCom Wireless Worldwide **Booth 852**
Existing products
Mobile, portable and accessories for two-way radio communications including Motorola, ICOM and Nextel; rental; sales; service; product management; systems integrations.
New products
Domestic and international distributions for wireless communications.
Circle 215

Biby Engineering Services **Booth 558**
Existing products
RFCAD signal-mapping software.
Circle 216

Carlson Wireless Telephone **Booth 1171**
Existing products
The i-WLL high-speed, Internet-ready, digital spread-spectrum, dual-line, license-free, wireless local loop telephone system.
New products
The i-WLL 56k; i-WLL repeater.
Circle 217 **See our ad on page 73**

Centurion International **Booth 843**
Existing products
2.4GHz antennas; SX antennas at UHF and VHF; batteries for two-way radios.
Circle 218

CeoTronics **Booth 552**
Existing products
TC917 radio headset; video headsets; CT475/575 ear microphones; covert

inductions systems; PTT headsets for use with more than 300 radio models; wire-com intercom headsets; speaker microphones; heavy-duty cellular headsets; lightweight headsets; intrinsically safe headsets; custom products.

New products

Lightweight headsets; covert induction systems; video products.

Circle 219 **See our ad on page 74**

CES Wireless Technologies **Booth 309**

Existing products

Mobile/status message terminals; GPS automatic vehicle location; credit card devices; single/multiple dispatch and mapping software systems; microphones; telephone interconnects and repeater makers operating over conventional, analog/digital trunking radio; CDPD, satellite or any supported analog or serial-driven radio device.

New products

GPS-210 CDPD automatic vehicle location; CRD-600 vehicular credit card terminal; Quick-trak mapping software; GPS-210 AMPS automatic vehicle location.

Circle 220

ChargeGuard **Booth 124**

Existing products

Chargeguard automatic on-and-off timer switch for two-way radios, cellphones, mobile computers; Shopware software for the two-way communications industry.

Circle 221 **See our ads on page 36 & 42**

Cimarron Technologies **Booth 248**

Existing products

Skymark Vehicle Tracker GPS-based automatic vehicle location system operating over CDPD, trunking or conventional radio; CEU-2 and QE-2 encoders; CMARK decoders.

New products

ANI products; CEU-2 encoder, QE-2 encoder; QPF PC programmer; CMARK I, II, III, IV decoders; AVL products.

Circle 222

Citel America **Booth 757**

Existing products

RF coaxial surge protectors; ac power panel protection for wireless and radio base stations; T1/E1 surge protectors; RS-485, RS-422, RS-423 surge suppressors; surge-arrester, gas-tubes components.

New products

Model P8AX09NMF coaxial surge protector with custom-made gas discharge tube for low insertion loss (less than 0.06dB at 25GHz).

Circle 223 **See our ad on page 76**

Com-Net Ericsson Critical Radio Systems **Booths 401 & 1075**

Existing products

EDACS radios; Jaguar 700 series portable radios.

New products

The Panther family of conventional products that are compact, lightweight portables. This family includes Panther 300P, Panther 300M, Panther 500P and Panther 500M.

Circle 224 **See our ad on page 27**

Computer Resources **Booth 842**

Existing products

Mobile radio billing; micro IDEN billing and provisioning; pager billing; MRIDA and MRISM Motorola trunking automation software, service, sales management and all accounting; complete turnkey systems, software, hardware, training, installation and support.

Circle 225

ComSpace **Booth 825**

New products

Digital LTR radio and base station designed to allow one-channel-at-a-time migration, using existing analog infrastructure. At 25kHz, DC/MA technology (digital channel/multicarrier architecture) transforms one analog channel to eight digital channels and provides a coverage area equivalent to a standard FM footprint.

Circle 226

CPI Communications **Booth 743**

Existing products

Dc remotes; dc termination panels; tone remotes; tone termination panels; local extensions; multichannel remote controls.

Circle 227 **See our ad on page 71**

Crouse-Hinds Obstruction Lighting **Booth 458**

Existing products

L810 obstruction lights; L864/L865 beacons,

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controllers and associated accessories.
Circle 228

Crystal Group **Booth 1170**
Existing products
CS500 computer chassis; CS1000 computer chassis; telecommunication wireless rack equipments; storage systems; systems integration; CPU cards; technical services; consulting; servers.
New products
2m high CS600 computer chassis; alarm/monitoring systems; Datareach KVM extender card; Web server/appliance.
Circle 229

CTI **Booth 419**
Existing products
Opti-page; TNPP-310; Pagemaster phase II alpha; Mitee-page alpha; PR-150; TXC-200.
Circle 230

Daniels Electronics **Booth 1328**
Existing products
MT-3 VHF, UHF, lowband VHF, 800MHz, 900MHz repeaters and base stations.
New products
Project 25-compliant MT-4 digital radio systems; multiple receiver rack.
Circle 231

Data Comm for Business **Booth 573**
Existing products
SR-VM voice data multiplexer; access switch for remote management.
New products
X2 wireless/dial-up modem.
Circle 232

David Clark **Booth 425**
Existing products
Headsets with push-to-talk adapter cords for mobile and portable radios; voice-activated headsetsfor portable radios; headset intercom systems with two-way radio interface.
New products
Model C6501 headset adapter for interface with Nextel digital cellphones: compatible with all H6000 series over-the-head and behind-the-head headset styles; model H6020 headset with noise-shielded microphone for use in high noise: will interface with more than 300 land mobile radios.
Circle 233 **See our ad on page 35**

David Levy Company **Booth 417**
Existing products
First Source installation software; Prolink installation accessories; Black Widow vehicle security systems and accessories; test equipment.
Circle 234 **See our ad on page 65**

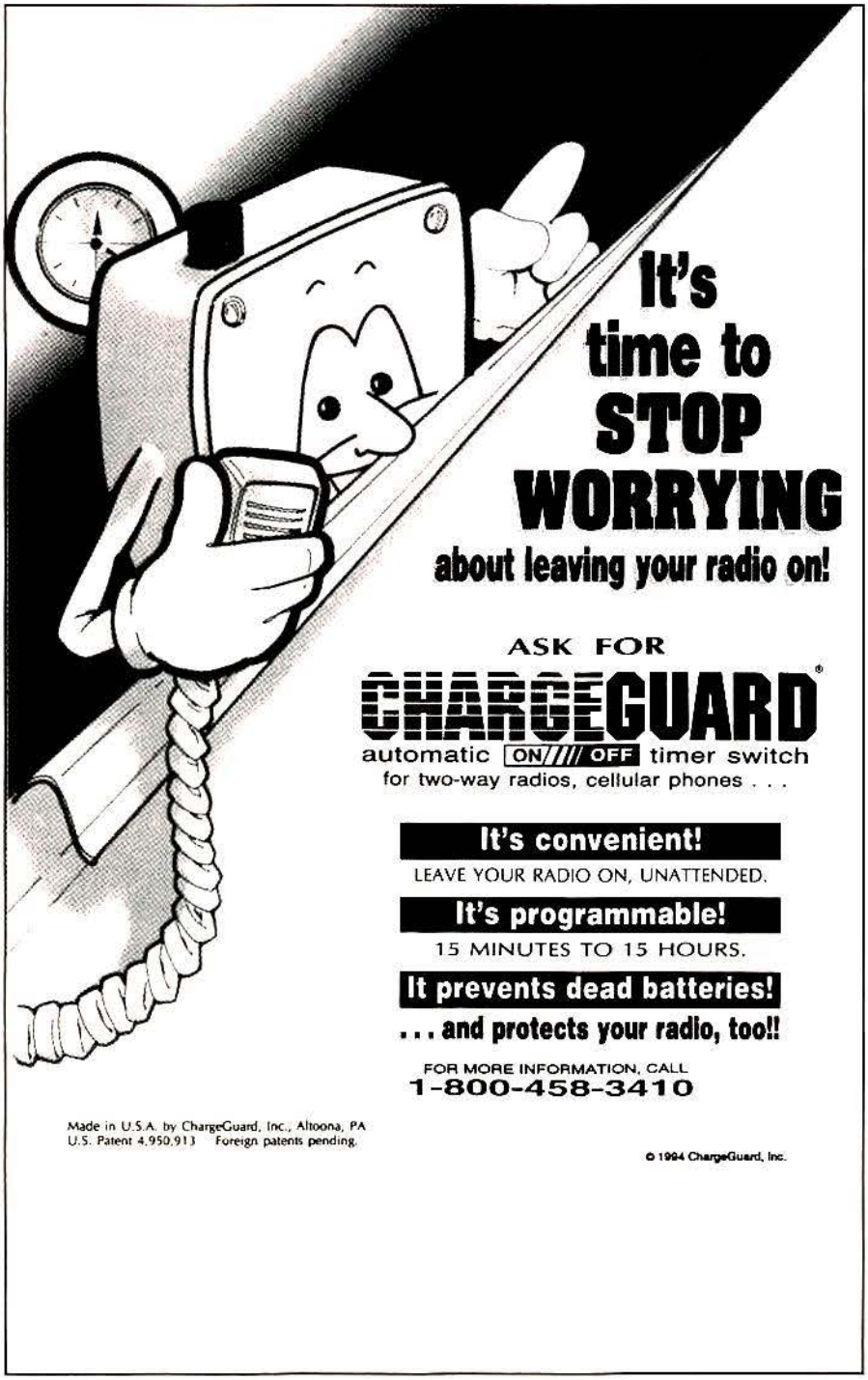
Day & Cukier **Booth 1074**
Existing products
Full range of legal services for wireless telecommunication companies including licensing matters, rulemakings, adjudications, experimental/developmental authorizations.
Circle 235

Dupont Building **Booth 1453**
Existing products
Environmentally sound, non-corrosive fiberglass equipment; auxiliary power systems; shelters that provide protection of equipment suitable—to any environment.
Circle 236

Duracomm **Booth 431**
Existing products
LD series desktop power supplies; MB and RM series rack-mount power supplies; MM and RM series battery backup modules; tone and voice pagers; OEM power supplies.
New products
High-power RM series power supplies.
Circle 237 **See our ad on page 82**

DX Radio Systems **Booth 833**
Existing products
Millennium repeaters and base stations; trunking systems (DXL-LTR series and DXM-MPT1327 series); paging transmitters; 400 non-simulcast series and 6000 simulcast series; radio telephone links RTD series; model 835 AM ground-to-air and 9800 model ground-to-air radios.
Circle 238 **See our ad on page 22**

Dyplex Communications **Booths 1381 & 1383**
Existing products
Phonak Phonito inductive earphone; Phonak in-the-ear VHF radio receiver; Phonak induction loops; Phonak surveillance kits for portable radios.
New products



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www.multiplier.com

Visit us at IWCE Booth #243.

Phonak Phonito low-noise inductive earphone.
Circle 239

Earmark **Booth 383**
Existing products
Series C headset radios; series S headset radios; Beltpak radios; Flexpak radios; a variety of microphones and headsets.
New products
Series S headset HS-45.
Circle 240 **See our ad on page 78**

Eartec **Booth 238**
Existing products
Industrial headsets for portable radios; noise canceling double earmuff—deluxe padded, single-ear and lightweight models offered.
Circle 241 **See our ad on page 79**

EDX Engineering **Booth 1142**
Existing products
EDX Signalpro general-purpose wireless system design tool; Signal multisite area-wide coverage and interference studies; MSITE multisite area-wide coverage and detailed link analysis interference studies; TPATH detailed single and multilink analysis including cross-link interference studies.
New products
New versions of all products listed above.
Circle 242 **See our ad on page 48**

I Paid for it the First Time I Used it!

We have heard this from so many customers that we thought we should share the thought with our prospective customers. The CableMate TDR is **THE LOWEST PRICED** true **graphical TDR** on the market today. This hand-held test instrument will allow you to find multiple shorts and opens **in coaxial or twisted pair cables** up to 2000 ft. in length. With the industry's **best RF filter,** you can spot cable problems in the worst RF environments you can imagine. Unlike waveform TDR's, the CableMate TDR is easy to learn and interpret. For experienced users, an external portable oscilloscope may be used for increased sensitivity and **waveform analysis.**

The CableMate comes standard with an **RS-232 serial computer port.** Optional applications software is available for **benchmarking cable installations** for future comparison and maintenance. A **cable library** giving velocity factor and impedance parameters for 66 cables is included. The user can add another 30 cables or change the existing cables listed.

A **zoom feature** allows the user to closely examine a small portion of a long cable. An exam mode with **cursor** lets you quickly determine the position of any suspicious fault showing up on the plot. This instrument is also ideal for quickly getting an accurate measurement of the amount of cable left on a reel.

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The AEA Division of Tempo specializes in hand-held test instruments for the wireless communications industry.

• Prices and specifications subject to change

Circle (32) on Fast Fact Card **Visit us at IWCE, Booth #1269**

ElectroComm Communications Systems **Booth 164**
Existing products
Invadr data and voice conventional radio; 19.2 radio/modem with diversity; base stations; high-power amps; in-vehicle computer.
Circle 243 **See our ad on page 5**

EML **Booth 1076**
Existing products
Communication service monitors; spectrum analyzers.
Circle 244

EMR **Booth 857**
Existing products
RF transmit combiners; receive multicouplers; cavities; duplexers; isolators; amplifiers.
New products
Low-band isolator.
Circle 245 **See our ad on page 54**

Epcom **Booth 353**
Existing products
Two-way radios and accessories; antennas; duplexers; cavities; coaxial cable; connectors; trunking systems and accessories; test equipment; paging systems; radio alarm systems.
New products
SKPG Kenwood radio programmer; ITS 10 kit for making repeaters with ICOM mobile radios.
Circle 246

Eventide **Booth 133**
Existing products
Digital voice-logging recorders.
New products
Web-based software options for remote access to existing logging recorders.
Circle 247

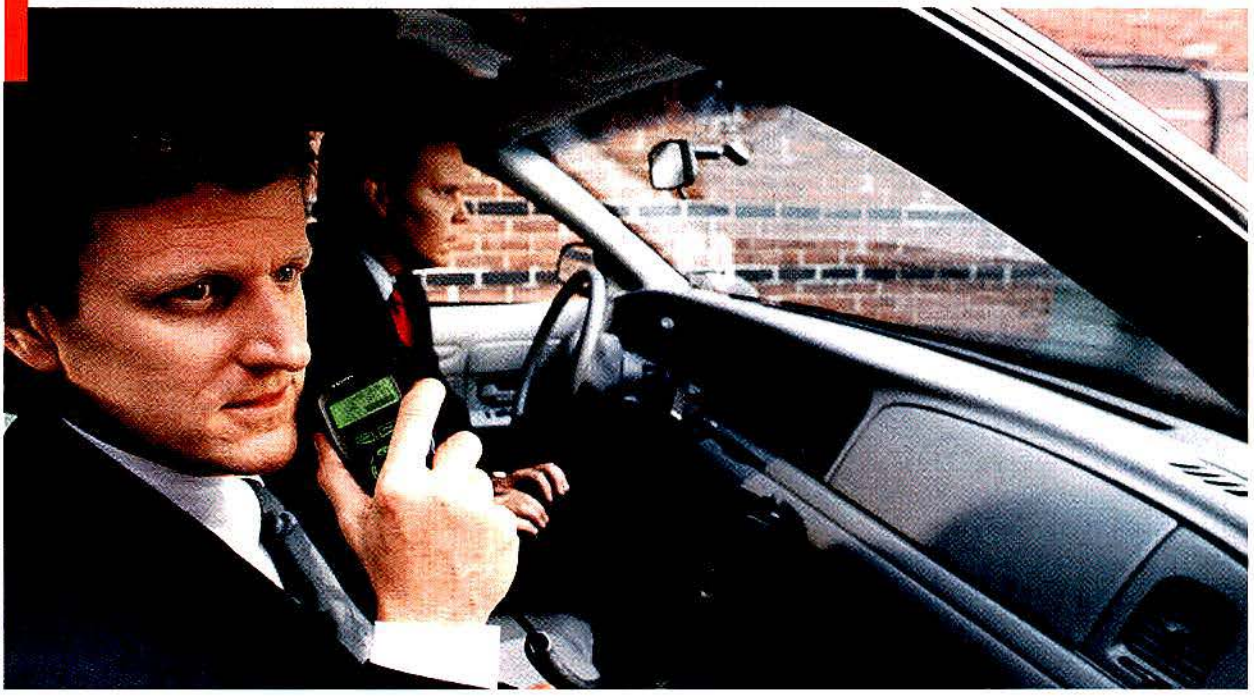
Federal Communications Commission **Booth 375**
Existing products
Universal licensing system; automated auctions software.
Circle 248

Fibrebond **Booth 1058**
Existing products
Concrete communications equipment shelters; guyed and self-supported communication/antenna towers.
New products
New-generation, lightweight concrete communications shelter
Circle 249

FreeWave Technologies **Booth 972**
Existing products
DGR-115 series 900MHz spread-spectrum radio modems; DGMR-115 series 2.4GHz spread-spectrum radio modems; DGR09 series 900MHz OEM transceiver boards; DGR24 2.4GHz OEM transceiver boards.
Circle 250

Futurecom Systems Group **Booth 846**
Existing products
Translating/on-channel repeaters; cross-band/in-band vehicular repeaters;

Not even Bond has it this good.



SENECA System

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The SENECA™ Secure Mobile Radio Control System represents a new generation in law enforcement communications. It works with multiple wireless transceivers to provide mobile agents with an unprecedented range of secure connectivity.

This powerful system is capable of everything from remote database access and imagery transmission to fingerprint identification and position tracking. The SENECA System meets APCO Project 25 standards, supporting all of these functions with both wideband and narrowband communications, ensuring the highest levels of security.

Harris is continually exploring ways to improve and expand the field of secure mobile communications. The SENECA System puts all the data you need right at your fingertips.

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multiband, smart line amplifier.
New products
Mobexcom II vehicular repeater.
Circle 251

Gabriel Electronics **Booth 1059**
Existing products
Spread-spectrum parabolic antennas, solids and grids; spread-spectrum directional flat panel antennas.
New products
Dual-band, spread-spectrum antennas.
Circle 525

GRE America **Booth 1339**
Existing products
GINA spread-spectrum radios—900MHz and 2.4GHz series; GINA WLAN 2.4GHz RF module; PCMCIA and ISA cards; GINA 4000 E-1 radios GHz 2.048Mbps.
New products
GINA 2200 radio/MUX 2.4GHz (fully integrated) last-mile telephone.
Circle 253

Harger Lightning Protection **Booth 882**
Existing products
Lightning protection and grounding equipment; surge suppression; communications grounding equipment; enhanced ground rods and engineering services.
New products

The Best Value in Two-Way Radio

The new PRYME MicroConnect™ line of two-way radios has something for everyone. These are powerful portables (5-Watts VHF or 4-Watts for UHF) that are truly palm-sized, measuring just 4.25" tall (excluding antenna)!

The radios feature brass reinforced knobs and a metal chassis for durability, and the back-lit LCD display helps the user keep track of the radio's status, even at night. The MicroConnect™ line of portables offers an impressive combination of power and capabilities.

Two versions of the MicroConnect are available, one for "dot" channel job site use and the other other for professional LMR applications

JobConnect Transceivers
8 Channel "dot" radios for job site use.
Available in VHF or UHF models.

ProConnect Trasceivers
99 Channels for professional users
Available in VHF, UHF, and VHF Low Band Models

* *Just 4.25 inches tall! (excluding antenna)*
* *5 Watts Output Power (4 Watts for UHF models)*
* *Includes CTCSS (38 tones)*
* *Available for VHF (138-174 MHz) and UHF (440-470 MHz)! VHF Low Band (38-50 MHz) Coming in May of 2000!*
* *Scan, Priority Scan, and Dual Watch*
* *Optional 16 digit keypad and DTMF paging are available*

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Circle (34) on Fast Fact Card **Visit us at IWCE, Booth #468**

Ultraweld exothermic connections.
Circle 254

Harris/Intraplex Transmission **Booth 1218**
Existing products
Intraplex Crossconnect system and server; Intraplex Securelink.
New products
Intraplex Access Server: T1/E1 multiplexer.
Circle 255 **See our ad on page 39**

Honeywell Obstruction Lighting **Booth 710**
Existing products
Flashguard 3000 FAA dual lighting system; 9LC series incandescent controls.
Circle 256

Hustler/New-Tronics Antenna **Booth 1409**
Existing products
Mobile, base and portable antennas for two-way communications, including Spirit model fiberglass omnidirectional base antennas; G1E and G7 series omni base antennas; LMG and LMB mobile model Motorola mount antennas; mounting kits; cellular mobile antennas.
Circle 257 **See our ad on page 58**

Hutton Communications **Booth 325**
Existing products
Site infrastructure products; radio communications equipment; wireless telephone accessories; power systems products; test and shop equipment.
New products
2BV19R system enclosure: a NEMA 3R painted aluminum enclosure featuring a separate battery compartment that accommodates two 75A hour batteries and a slide-out 19" rack mount that accommodates two radios and a rectifier.
Circle 258

ICOM America **Booth 801**
Existing products
VHF and UHF portables and mobiles; desktop repeaters; receivers; avionics.
New products
F4TR passport portable with LTR; F36S, F36T VHF portables; F46S, F46T UHF portables; UT-111 LTR trunking module.
Circle 259

ICT **Booth 1325**
Existing products
Desktop switching power supplies; customized base station covers; wide-range, high-power supplies; isolated and non-isolated dc-to-dc converters.
New products
Switching power supplies with LED display; wide-range isolated converters; smart battery chargers.
Circle 260

IDA **Booth 601**
Existing products
Trunking controllers; tone and digital remote controls; DTMF microphones; LTR conversion kits for Motorola radios; the Trakit-AVL vehicle tracking system.

New products
Net-Link MP dispatch networking system for UHF trunking systems.
Circle 261

Idaho State University **Booth 177**
Existing products
RF technicians from the RF and telecommunications program.
Circle 262

International Wireless Telecommunications Association (IWTA)/ American Mobile Telecommunications Association (AMTA) **Booth 753**
Existing products
Global Digest for Commercial Trunked Radio Systems; Operations Manual for Commercial Trunked Radio Systems; Marketing Guide for Commercial Trunked Radio Operators; Worldwide Directory of Commercial Trunked Radio Operators.
New products
Commercial Trunked Radio Technology Overview; Worldwide Directory of Two-Way Radio Dealers.
Circle 263

ITECH (Intelligent Technologies) **Booth 1070**
Existing products
IQten programmable battery test system.
Circle 264

JPS Communications **Booth 128**
Existing products
ACU-1000 modular interconnect system; NRU-600 noise reduction unit; SNV-12 signal-to-noise voter.
Circle 265 **See our ad on page 68**

Kantronics **Booth 968**
Existing products
UHF/VHF modems; HF modems; GPS tracker; paging arbitrator.
New products
Page controller.
Circle 266 **See our ad on page 83**

Kaval Telecom **Booth 964**
Existing products
OFR repeater; BDA 1200 bi-directional amplifiers (400MHz, 800MHz, 900MHz); patented signal taps and distributed antenna networks.
New products
OFR 1000 network system; fiber-fed BDA fiber-optic bi-dimensional amplifier.
Circle 267

Kenwood Communications **Booth 101**
Existing products
90 series public safety mobiles and portables; complete line of trunking mobiles and portables; TK-260G/360G and TK-270G/370G multimode portables; TK-760G/860G and TK-762G/862G mobiles; Freetalk UBZ-HL14 and UBZ-AL14 models; TKR 8300 repeater.
Circle 268

KRW United **Booth 1161**
Existing products
RAD XDSL modems; RAD fiber-optic modems; RAD Internet/Intranet access routers; RAD rate and standard converters; Moseley NX64 fractional digital point-to-point radio.
New products
Moseley NXER point-to-point digital radio 335MHz–512MHz, 790MHz–960MHz, 1,350MHz–1,535MHz, 2,000MHz–2,200MHz, 64kbps–2,048kbps in 64k steps, 2 E1/T1, 4 E1/T1, QAM modulation; RAD Megaplex 2100 hybrid-TDM/ frame relay multiplexer.
Circle 269

Kullman Industries **Booth 676**
Existing products
MTSO buildings; modular equipment; switch stations; COWS.
Circle 270

Leavitt Communications **Booth 757 & 860**
Existing products
Motorola pagers, programming software (warranty and non-warranty), parts and accessories; Motorola TS11 radios; Motorola batteries, parts and accessories; Alphamate 250 on-site paging products; IDEN parts and accessories.
New products
Panasonic factory-refurbished consumer electronics products.
Circle 271

Link Communications **Booth 368**
Existing products
RLC-CLUB repeater and linking controller;

Circle (35) on Fast Fact Card
Visit us at IWCE, Booth #125

RLC-ANG analog telemetry controller.
New products
CSM1000 communications service monitor.
Circle 272 **See our ad on page 83**

Lyncole XIT Grounding **Booth 461**
Existing products
Active electrolytic grounding systems; XIT rod for protection of electronic equipment against lightning and other electrical disturbances; AEMC test meters; seminars on grounding system design and testing.
Circle 273

Marvair **Booth 1465**
Existing products
Slimpac ECU-18 1½ ton environmental control unit; Commcool ECU-24 environmental control unit.
New products
Compac 3 HVAC system (air conditioner); Compac 4 HVAC system (air conditioner); Commstat3 lead/lag controller for air conditioners.
Circle 274

Maxon/Topaz3 **Booth 525**
New products
SP-200 series portables (Maxon); SP-300 series portables (Maxon); SM-3000 mobiles (Maxon); SM-6000 mobiles (Maxon).
Circle 275

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Maxrad **Booth 1109**
Existing products
Maxrad's complete line of mobile, portable and base station antennas for frequencies ranging from 27MHz to 5.8GHz.
New products
WMLPV low-profile vertical antennas for ISM, PCS, 800MHz/900MHz and UHF frequencies in white; MP24015 and MP24017 directional panels for 2.4GHz frequencies and 15dBi or 17dBi of gain; MFB24010 omnidirectional fiberglass antenna with 10dBi gain.
Circle 276 **See our ad on page 44**

MCM Technology **Booth 1275**
Existing products
Information technology systems for mobile communications companies including Realtime service management, inventory control paging, mobile radio billing, purchasing and full accounting.
New products
Realtime service management; Realtime mobile radio billing; Realtime pager management; Realtime sales management.
Circle 277

Metric Systems **Booth 415**
Existing products
Mavric 2000nx, an IP-based wireless data and voice Internet working router/controller that allows users to build Web-centric multipoint licensed or unlicensed wireless voice and data networks with full-duplex data rates from 256 kbps to 3.08Mbps.
New products
Mavric Explorer II is a ruggedized low-power, wireless Internet working controller and router designed for the industrial automation marketplace that allows users to wirelessly migrate from non-networked-based monitoring and control systems to the next generation of Internet and Web-centric systems. The Mavric Explorer II licensed or unlicensed full-duplex data rates range from 256kbps to 3.08Mbps.
Circle 278

Micro Infinity Services **Booth 873**
Existing products
Southware business software
Circle 279

Midian Electronics **Booth 524**
Existing products
TVS-2 (rolling code scrambler); RC-10/RD-10 remote control; Maxon plug-in boards; VPU-11 and VPU-12 inversion scrambler.
New products
MOT-TVS-2 Pro (scrambler for Motorola Pro radios); TRE-1 (tone remote encoder); TDM-1 (transparent data modem).
Circle 280

Midtronics **Booth 3560**
Existing products
Micro Celltron (CTM-100) digital battery analyzer with available accessories, including printer, clamp and probe cables; carrying case, amp test connector, temperature sensor; PC data receiver and software; battery monitor (MCT-148) for 24V or 48V strings.

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- Combiners
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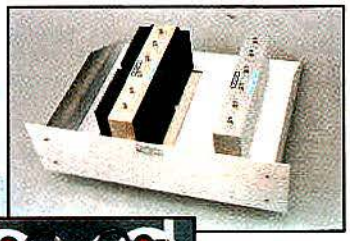

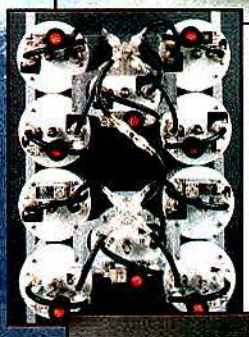

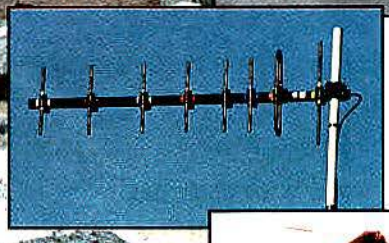

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Wireless Communications Manufacturers Since 1972

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Visit us at IWCE Booth #619.

New products

CTM-ETD end-of-train-device battery tester.

Circle 281

Mobile Radio Technology Booth 249

Existing products

Mobile Radio Technology is recognized as the leading source of technology-focused industry guidance. Readers include mobile radio dealers and service shops, large-volume end-users at public safety, government, transportation, business and industrial agencies, as well as paging and SMR service providers, and manufacturers and their reps and distributors. The editorial stresses the latest in equipment and applications, business developments, legal and regulatory matters. Visit our booth to pick up a copy, and sign up for your free subscription.

Circle 282 **See our ad on page 53**

Multiplier Industries Booth 1251

Existing products

Rechargeable two-way and cellular batteries; current battery models: Motorola, Kenwood, Ericsson/GE, Midland, Philips, Vertex Standard; intrinsically safe models; wide variety of batteries for international radios.

New products

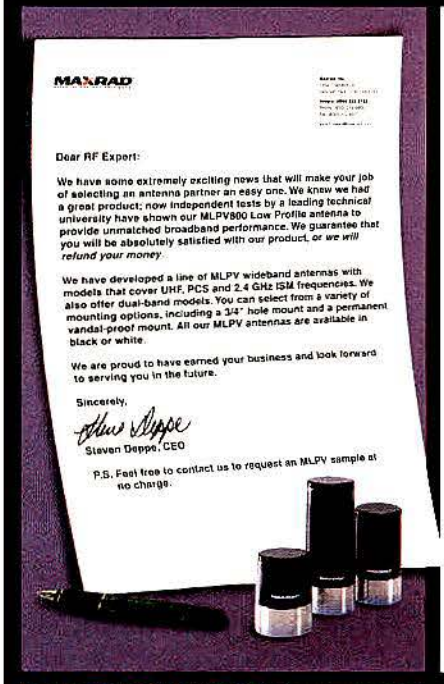
Replacement batteries for: Motorola Saber P/N M459SH, Motorola i1000 P/N M8614, Motorola XTS-3000 P/N M8294, Motorola HT 750/1250 P/N M9012.

Circle 283 **See our ad on page 37**

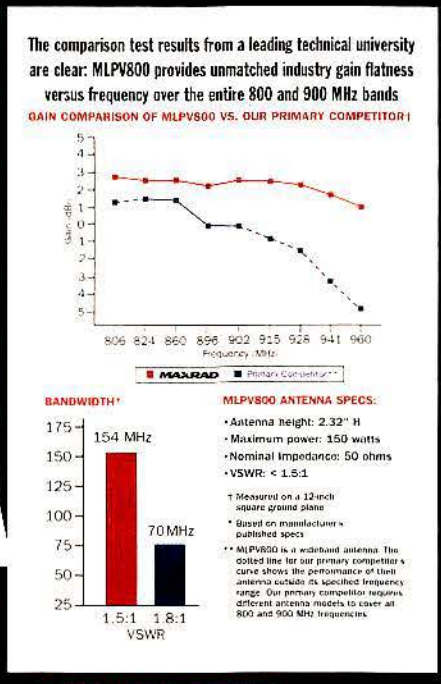
YOU CHALLENGED US.

WE DELIVERED. MAXRAD LOW PROFILE.

TESTS SHOW MLPV800 PROVIDES UNMATCHED BANDWIDTH PERFORMANCE.



The comparison test results from a leading technical university are clear: MLPV800 provides unmatched industry gain flatness versus frequency over the entire 800 and 900 MHz bands



OTHER IMPRESSIVE FEATURES:

- Efficient radiator design made of solid brass. No lossy circuit boards utilized.
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- UHF, PCS and 2.4 GHz ISM wideband models available.
- Dual-band models available.
- All models also available in white.

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Natcom Booth 143

Existing products

Motorola pagers and products; Visiplex paging infrastructure (VS2001 and VS3100); Zetron paging infrastructure (model 640XTRA and Pagecenter).

Circle 284

NCG Booth 456

Existing products

2.4GHz mobile, base station and directional antennas; VHF/UHF dual-band mobile and base station antennas; DAIWA cross-needle SWR/power meters and coax switches.

New products

DAIWA CN-801S 900MHz cross-needle SWR/power meter.

Circle 285 **See our ad on page 60**

Newmar Booth 321

Existing products

Power supplies; battery chargers and dc converters for mobile and fixed site applications; integrated power system IPS series; rack accessories: LVR low-voltage disconnect, DST power distribution board, MTR meter panel.

New products

PM series power modules; PFM-200 power function manager modular power system for 48V, 24V, 12V positive/negative ground systems, multifunctional and adaptable to virtually any site dc power requirements.

Circle 286 **See our ad on page 81**

NexTek Booth 152

Existing products

PTC series; PTR series; QWS series; Bias-tee; Bias-tee with lightning.

New products

NTVSS9; NTVSS9M; PTX series.

Circle 287

NK Cables/Teracom Components Booth 1429

Existing products

RF coaxial cables; RF coaxial connectors.

New products

NK Cables: Ohmax colored cables; Teracom: new one-piece connectors for 2¼", 1¼", ½" and 1⅝".

Circle 288

Northpoint Communication Products Booth 1065

Existing products

Lopro low-profile antennas; NP19000 series PCS; NP8000 series cellular; NP8500 series 800MHz trunking; NP9000 series 900MHz trunking.

New products

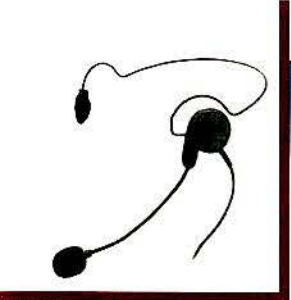
Lopro low-profile antennas; NP19000 series PCS; NP24000 series ISM; NP15000 series amplified GPS; NP20000 series PCS/cellular dual band.

Circle 289

Novatel Wireless Booth 781

Existing products

Wide-area, wireless data modems.



Have You Heard?

May 1999...
OTTO purchases Sonic Communications, Inc.

With our recent acquisition of Sonic Communications, Inc., OTTO has greatly strengthened its position as the leading supplier of high-performance audio products for the two-way radio communications market worldwide.

Now OTTO and Sonic products combine to provide the most comprehensive line of two-way radio accessories available anywhere. With our purchase of Sonic, OTTO has acquired many new technologies that will immediately be available to you under the OTTO Communications name. Viper headsets. Throat and skull mics. Ear transceivers. Motorcycle and bike patrol kits. Body and ring PTT switches. And much more. All under one broad spectrum of specialty audio expertise.

Which is good. Because now that OTTO and Sonic have become one – the whole world communicates a whole lot better.

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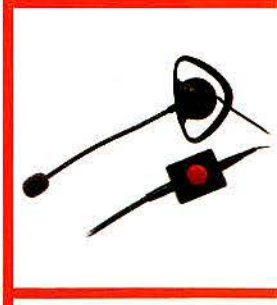


New products

Expedite family of OEM modules; Merlin PC card; Minstrel V modem; Custom Engineering Solutions team; Metricom modem; GPRS modem.

Circle 290

Nutel Wireless **Booth 718**

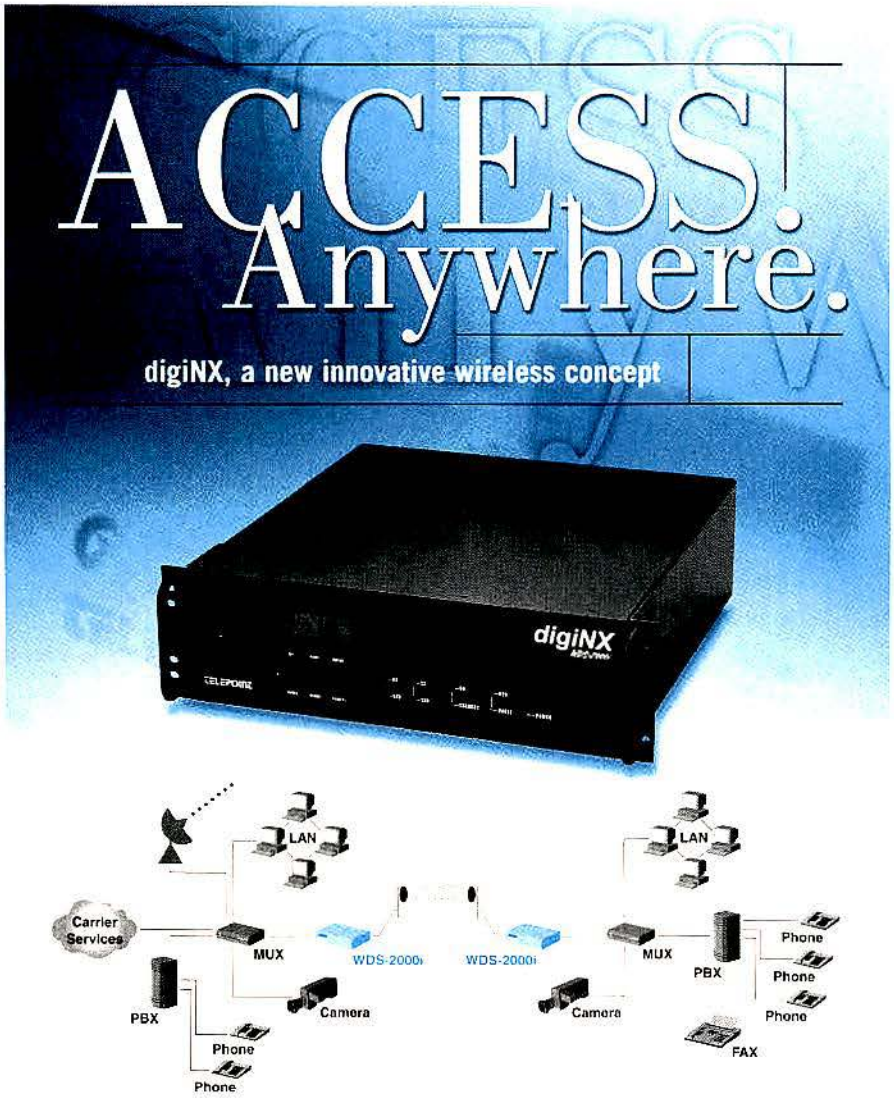
Existing products

Point-to-point, analog and multiple T1/E1 digital microwave radio systems from 960MHz to 23GHz, both licensed and spread-spectrum unlicensed. Point-to-multipoint wireless IP network routing; broadband wireless transport for 100Mbps Ethernet +2T1; wireless LAN Ethernet up to 10Mbps.

New products

Stratum 100 high-capacity, wireless transport for 100Mbps Ethernet + 2T1; M400 4T1/E1, 2.4GHz/5.8GHz, spread-spectrum, point-to-point microwave radio; Lynx.sc6DS3, DS3, 45Mbps, spread-spectrum, 5.8GHz, point-to-point radio; Winrouter 2050, 2.4GHz, wireless IP, network router at 768kbps full-duplex; RangeLAN5 24Mbps, wireless, networking HiperLAN to European and U.S. standards; Mobilink 140 wireless, one-piece, 10Mbps PC card for laptop networking. Nutel Wireless is a registered trademark of Nutel Electronics.

Circle 291



The digiNX Wireless Delivery System (WDS) provides a symmetrical wireless connection that simultaneously supports robust voice, data and video for low to medium capacity Virtual office Private Networking applications. It also links telephone access to low subscriber density areas as well as PCS networks. Therefore eliminating leased services such as analog ISDN, Frame Relay PVCs or T1/E1. Experience the wireless difference today! Call Telepoint for more information.

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Circle (40) on Fast Fact Card **Visit us at IWCE, Booth #747**

Ormandy **Booth 771**

Existing products

Integrated software that serves accounting, customer care, service, usage/rating and other needs of customers in the two-way, paging and cellular industries.

New products

SMR and pager activation and billing; Powerpak, an interface for Motorola's Powerlink; integrated program for the cellular industry.

Circle 292

Optoelectronics **Booth 955**

Existing products

Frequency counters; frequency recorders, DTMF decoder; nearfield test receivers; PC-controlled communications receiver active preselector; CTCSS, DCS, LTR and DTMF tone decoders; RF detector.

New products

CD100 multicounter; Optocom PC-controlled receiver with Comcounter.

Circle 293

PageTek **Booth 1281**

Existing products

Protek jr+ remote site monitor; Protek expandable remote site monitor.

New products

Gatekeeper remote site access control system; Protektor + mini remote site monitor; Sitemanager centralized alarm monitoring software.

Circle 294

Panorama Antennas **Booth 876**

Existing products

Complete range of mobile and portable antennas from 30MHz to 3GHz with GPS range, including the combination VHF, UHF or cellular, as well as GPS in one antenna mount.

New products

Internal dual-band amps/PCS TAP-3F (on glass), GPS range, GPSM, GPSP, GPSK, magnetic, panel and Kombi, respectively.

Circle 295

Pyramid Communications **Booth 118**

Existing products

2012 mobile data terminal with optional internal GPS; SVR200 synthesized vehicular repeater.

New products

Model 2012 mobile data terminal with optional internal GPS.

Circle 296

Racing Electronics **Booth 514**

Existing products

Race communications system; wiring products; ear pieces; headsets; scanners and accessories.

New products

Headsets; radio equipment.

Circle 297

Radiall/Larsen Antenna Technologies **Booth 407**

Existing products

Mobile, portable and small base antennas from 27MHz to 3.5GHz.

New products

Your *Other* Source
For Wireless Infrastructure

Link Transmitters

(72 MHz, VHF, UHF, 900MHz)

Other manufacturers have recently discontinued the production of Link Transmitters, especially those at 72 MHz. Eagle Wireless International has stepped forward and will continue to manufacture and distribute this highly useful product. Because Link Transmitters offer a wide variety of options, frequencies, and power; we believe them to be an integral part of the paging industry. Our transmitters are the answer to many paging problems.

The EAGLEPOWER and COMPACT SERIES of high, medium, and low power Link Transmitters come fully equipped with FCC Type Accepted exciters.

All EAGLEPOWER Transmitters above 100 watts come equipped with the Eagle Heat Trap™ design to provide the user with long life high reliability performance even under the most extreme operating conditions.

The small footprint of all Eagle Wireless Transmitters allows easy interface in most existing cabinets or in the optional slimline cabinet provided by Eagle Wireless.

The Eagle Wireless Transmitters also have power and frequency options covering all of the many combinations of system requirements found in today's paging and SMR systems.

FEATURES INCLUDE

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Eagle Wireless International is a Value Added Reseller for Lucent Technologies.

Circle (41) on Fast Fact Card

GPS timing antenna for base station applications; halfwave dipole antennas for 800MHz, 900MHz, 1,800MHz and 2,400MHz terminal applications; VHF low-profile mobile antenna.
Circle 298

***Radio Resource* Magazine** **Booth 232**
Existing products
Radio Resource Magazine is dedicated to satisfying the information needs of radio communications system managers. The "Public Safety Report" offers detailed and comprehensive information on the rapidly expanding and changing public-safety market. *Radio Resource International* provides practical information for organizations participating in the international wireless communications market.
Circle 299

RadioSoft **Booth 365**
Existing products
Comstudy 2.2.
New products
Frequency finder.
Circle 300

Raine **Booth 755**
Existing products
Nylon cases and pouches for two-way radios, cellphones and pagers used by public safety, police, military, outdoor sports and industry.
New products
Horizontal cellphone cases.
Circle 301

Remec Walcom **Booth 1153**
Existing products
Coaxial cavity filters, duplexers, transmitter combiners, receiver multcouplers systems operating in the 30MHz to 960MHz band.
Circle 302

RF Imaging & Communications **Booth 704**
Existing products
Used radio communication service monitors; general test equipment; HP, IFR, Motorola, Marconi, Stabilock, Cushman, Wavetek, spectrum analyzers; cellular test equipment; PCS test equipment.
New products
Protek 2GHz RF field analyzer 3201; L/G SA-7270 2.7GHz spectrum analyzer.
Circle 303

RF Neulink **Booth 675**
Existing products
RF9600 VHF and UHF radio modems; SS9600 spread-spectrum 2.4GHz; crystal control link radios; SCADA modules.
New products
Neulink SS19200 spread-spectrum 2.4GHz.
Circle 304

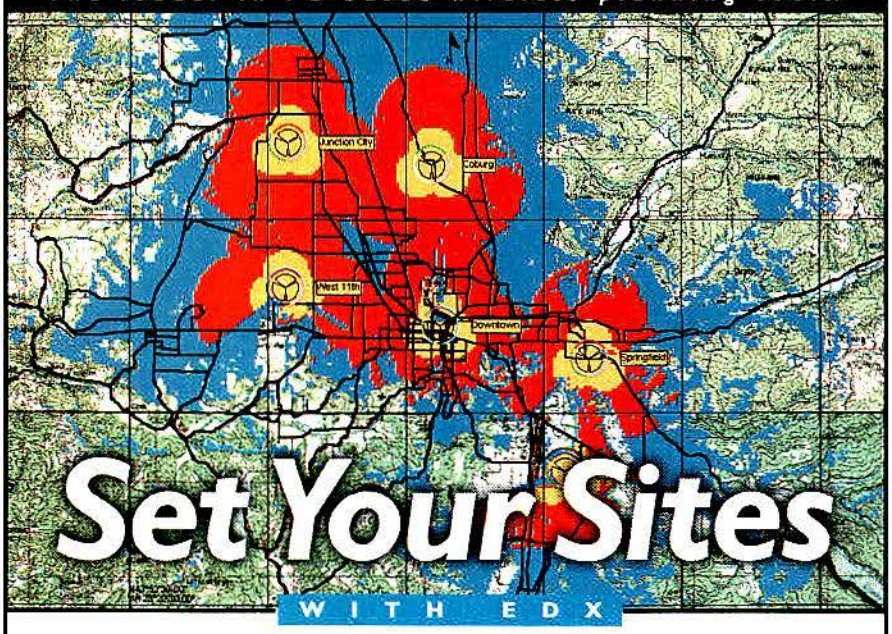
RF Technology **Booth 1057**
Existing products
Eclipse base stations; repeaters; links-associated equipment; solid-state antenna switches; power supplies.
Circle 305

Samlex America **Booth 345**
Existing products
SEC series switching power supplies and base station power supplies; AC Power Source dc-to-ac inverters; N+1 dc power system; SEC series automatic battery chargers.
New products
N+1 redundant dc power system; SEC-40RM 40A power supply; SEC-60RM 60A power supply; SEC-80RM 80A power supply; SEC-100Rm 100A power supply.
Circle 306

SCA **Booth 165**
Existing products
CPAV01 VHF tone/voice pager; CPAV02 UHF tone/voice pager; SH-780 exciter VHF digital pager.
New products
CPAV03 low band pager; options on pagers: voice storage and scan.
Circle 320 **See our ad on page 64**

Securicor Wireless **Booth 811**
Existing products
70-0000 series Bantam, Titan FM mobile radios and accessories; 70-0000 series Bantam, Syn-tech XTR FM portable radios and accessories; 70-0000 series Base-tech FM base stations and repeaters; 75-0000 series linear modulation 220MHz mobiles, portables and repeaters; DE-2000 series mobile data computers, AVL modules and terminals.
New products

The leader in PC-based wireless planning tools.



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Only EDX offers you advanced wireless planning tools that can meet the needs of the simplest or most sophisticated system. Cellular, PCS, paging, mobile radio, LMDS and broadcast systems throughout the world have been successfully designed and optimized with EDX planning tools.

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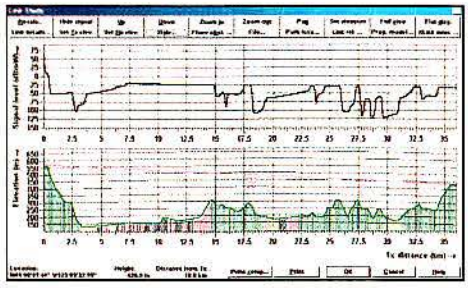
For 14 years EDX has been the leader in PC-based wireless planning tools. Contact us today for more information and a fully operational demo CD.



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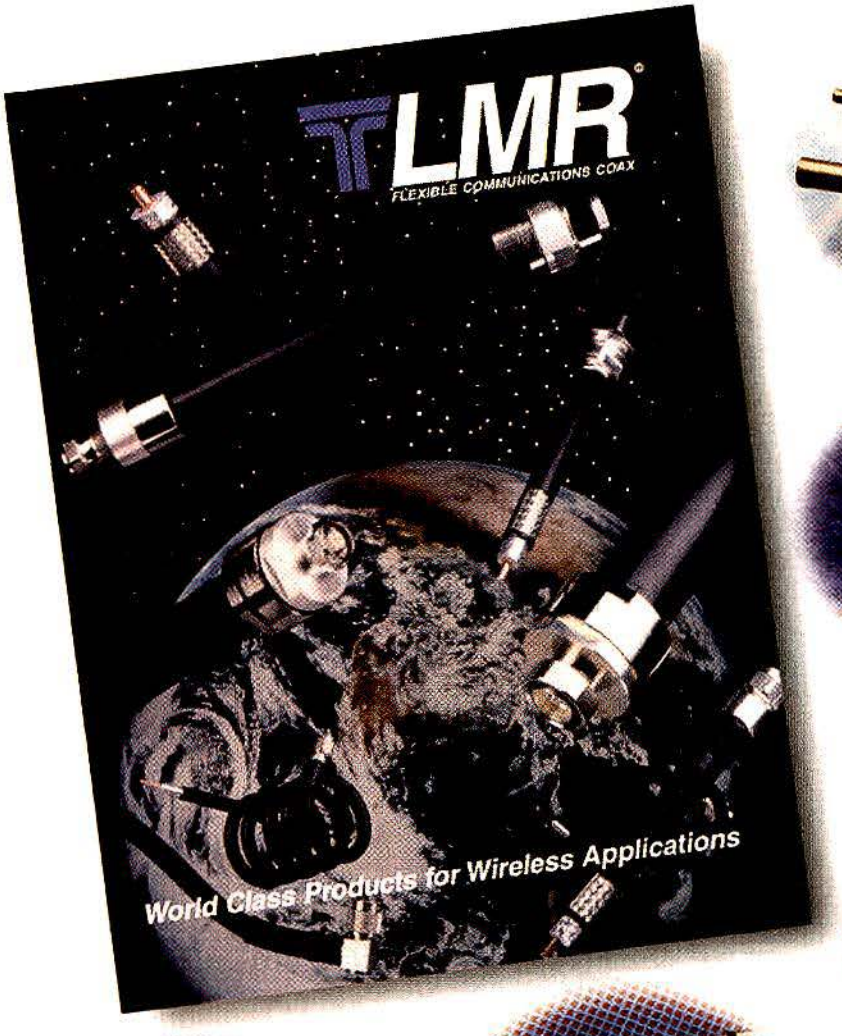
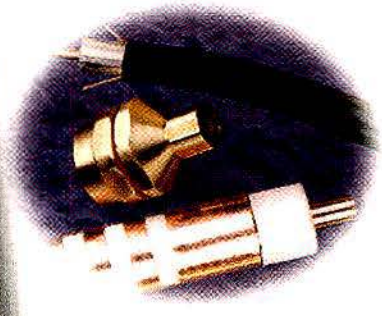


LMR®- DB Flexible Watertight Coaxial Cables



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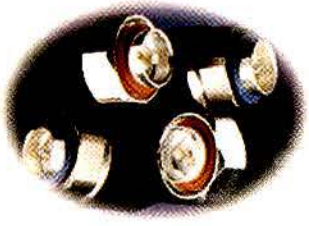

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For information on Primus: Circle (87) on Fast Fact Card
For information on Times Microwave: Circle (43) on Fast Fact Card

75-T1540-00 ADNT II network node (switch); 70-0000 series Titan low-band FM mobile radios; 70-2184 programming microphone for Titan mobile radios.

Circle 312

Schwaninger & Associates **Booth 532**

Existing products

Law firm in Washington, DC, represents persons and companies before the FCC. Its approach to practicing law is simple: It tries to help clients define and reach goals in a way that won't "break the bank."

New products

Areas of expertise: FCC auctions, paging, interconnection, broadcast, specialized mobile radio, cable, microwave, towers, public safety, rural telephone and radio common carrier. From brokering a deal to negotiating and drafting the contracts, the firm can handle any telecommunications transaction needs.

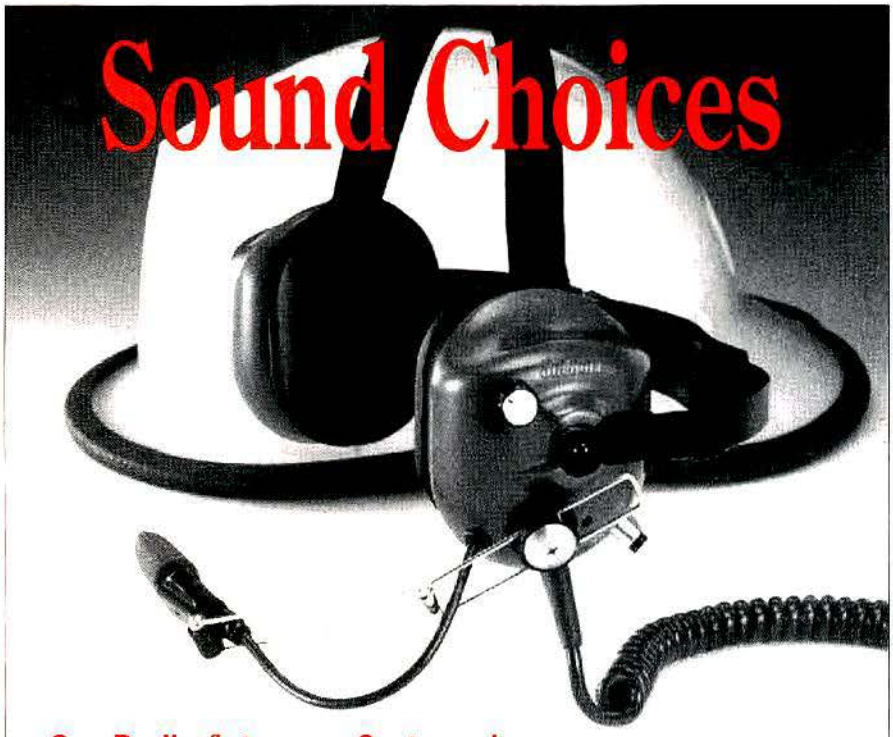
Circle 341

Scientific Dimensions **Booth 536**

Existing products

9900 series mobile workstation and cab organizer; 7277 Panasonic CF25 and CF27 mobile computer mount; 7276 universal laptop holder; 4101 LED "Cool Lite"; 7200-IMP-2 Impala police console mount and 7200 Crown Victoria console mount.

Circle 307



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Meet NFPA standards with the best sounding noise attenuating headsets available, headsets that can also be used with your portable radios. Engineered RFI/EMI and ground loop protection. Product reliability developed through 22 years experience justifies our two year warranty, a benchmark for the industry.

System 900

A single radio model with basic features cuts cost not corners. Headset has PTT and volume control; uses standard 1/4" phone plug.

System 930

A dual radio system designed for use with EMS vehicles. Offers simultaneous transmission, balance controls, intercom mute and more.

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All models are fully-assembled and easily installed. Our full line of single and dual radio systems ensures that you receive needed performance for the lowest cost.

Also Available:

- System 1300 with Split Audio for ARFF vehicles
- Pumper Panel/Driver Headset for vehicles not requiring intercom systems.

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Setcom **Booth 443**

Existing products

Portable and mobile headsets; portable and mobile helmet kits; vehicular/intercom radio mixers; pumper panel headsets for fire apparatus; police motorcycle comkits; police bicycle comkits.

New products

Phantom headset, model BLH; radio adapter model BMZ2; handlebar PTT and PTT extension cable

Circle 308 **See our ad on page 50**

Shure **Booth 1048**

Existing products

Modulink family of microphones; 810 speaker microphone; ALM interchangeable cordsets; microphone accessories.

New products

LMPI-A inline preamplifier; S98T aircraft microphone.

Circle 309

Simulcast Solutions **Booth 1258**

Existing products

Spectracom model 8195 ageless master oscillator; convex models 2042 and 2046 delay/equalization systems; JPS Communications model SNV-12 voter comparator; Harris-Intraplex TDM multiplexer family.

New products

Survey Technologies STI 9400 coverage analysis system; Convex model VDL-2M variable audio delay module.

Circle 310

Sinclair Technologies **Booth 737**

Existing products

Comshel-15 communications shelter; SRL307 yagi antenna 406MHz–512MHz; SRL406 yagi antenna 806MHz–960MHz; SUY-80606 yagi antenna 450MHz–470MHz; SRL441P data antenna 800MHz–1,000MHz; SRL411C4 enclosed dipole array antenna 806MHz–896MHz.

New products

SP-40-06S-14DOO broadband panel antenna 806MHz–960MHz.

Circle 311 **See our ad on page 24**

SmarTrunk Systems **Booth 725**

Existing products

SmarTrunk II; The Private Collection encryption devices.

New products

SmarTrunk II Omni logic boards for Motorola HT Professional series, Kenwood 'G' series and Standard HX290.

Circle 313

SoftWright **Booth 613**

Existing products

Terrain Analysis Package for Windows 95/98/NT 4.0 PC-based software to perform evaluation of existing or proposed transmitter sites; radio coverage predictions; TV and FM broadcasting, ITFS, PCS, SCADA, microwave, cellular, paging and two-way radio system design.

New products

TAP version 4.2 that includes graphic enhancements as well as creation of simultaneous multiple plots of coverage maps, profile graphs and antenna pattern plots.

Circle 314

Superior Performance, Maximum Flexibility

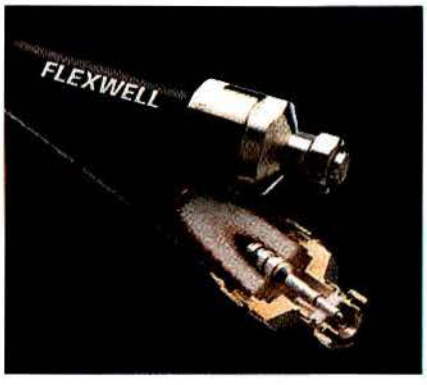
and Waterproof too!

FLEXWELL® Foam-Dielectric Coaxial Cable and Connectors

FLEXWELL cable features a copper corrugated outer conductor providing the superior performance you need along with maximum flexibility for ease in installation.

The proprietary closed cell design of the foam in FLEXWELL foam-dielectric coaxial cable coupled with Radio Frequency Systems' waterproof connectors ensures a uniquely waterproof system.

That's why, more and more, the wireless industry's preferred choice is Radio Frequency Systems' *FLEXWELL* coaxial cable, connectors and installation accessories.



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SONIK Technologies **Booth 1324**
Existing products
Pagepro paging transmitters; Pagelink paging data receivers; Dspage paging exciters; RF Audience II Reflex infrastructure receivers; Skyline wireless modems.
New products
PTX-150 VHF direct digital paging transmitter.
Circle 315

South Midlands Communications **Booth 269**
Existing products
Range of antennas (from Antenna Research Associates in same booth) mounted on Hilmast pneumatic telescopic masts.
New products
Fairhaven radio receiver.
Circle 316

Southwest PV Systems **Booth 1413**
Existing products
Solarex solar modules; Southwest Windpower air and Windseeker series; balance of system components include regulators, batteries, battery enclosures and mounting hardware.
New products
Solarex "SX" series of solar modules
Circle 317

Southwest Windpower **Booth 1451**
Existing products
Battery charging 400W wind generators with carbon fiber blades and internal regulator that can work solar panels in a hybrid system.
Circle 318 **See our ad on page 82**

Spectracom **Booth 1227**
Existing products
Netclock products: GPS master clocks; Timeview display clocks; Timeburst wireless time distribution network.
New products
Netclock network time provider; Ethernet time server; Netclock stratum time source; Timeview wireless display clocks.
Circle 319

Sunwize Technologies **Booth 1459**
Existing products
Powerready series small- to medium-size solar power systems; Portable Energy System solar charger for satellite phones, cellphones, laptops and field instruments; Power Radio solar powered system for telecom.
New products
Portable Energy Charger solar charger for small hand-held electronics; Sunwize MPR control system, MPR 9400, for solar/genset remote system control and monitoring.
Circle 321

Tad Radio of Canada **Booth 1110**
Existing products
TAD M10 VHF two-way radiotelephone and accessories and software packages; TAD portable VHF radiotelephone; Engenius 900MHz telephone.
Circle 322

Talley Communications **Booth 1051**
Existing products
Distributor of wireless communications infrastructure and mobile products, stocking more than 100 top manufacturers' products, including coaxial cable, connectors, base station, mobile and portable antennas, lightning protection, towers, test equipment, mounting equipment and more.
Circle 323

Teledesign Systems **Booth 236**
Existing products
TS4000 radio modem; TS2000 mobile radio modem; TSI9600 radio modem.
New products
Maximizer mobile antenna mount.
Circle 324

Telepoint **Booth 747**
Existing products
WDS-2000i digital radio.
New products
DigiNX WDS-2000i digital radio.
Circle 325 **See our ad on page 46**

Times Microwave Systems **Booth 919**
Existing products
LMR cable ranging from 100A to 1,700A; hardware accessories; connectors; installation tools; cable assemblies.
New products
LMR LLPL; reverse-polarity connectors.
Circle 326 **See our ad on page 49**

TMI Communications **Booth 1273**
Existing products
Mobile satellite communications products,

Nothing Beats A...

Quality Means Reliability ...

In todays marketplace, Diversified Electronics, Inc stands out as the Quality Leader you can always depend on.

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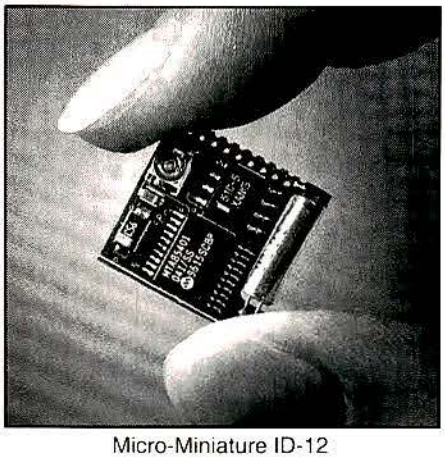
Digital ANI (Unit ID)
Motorola® MDC-1200® Format


Micro-Miniature ID-12

Manufactured by Control Signal®, the ID-12 ANI encoder is a cost-effective way to upgrade all the radios in your fleet with ANI that is compatible with Motorola MDC-1200. Works in all radios, and its tiny size (.59" x .65" x .12") allows it to fit in virtually all hand-helds. Has leading and trailing IDs, emergency, and time-out timer.

Coming Soon: MDC-1200 desktop decoder\display unit.

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And if for some strange reason you can't make IWCE this year, we'll make sure you don't miss a thing. Just head to our web sites and get the scoop.

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bringing you

IWCE:LIVE!
International Wireless Communications Expo

including asset tracking and management services; packet, circuit-switched data; voice, email, Internet access; dispatch radio.
Circle 327

Tower Connections **Booth 480**
Existing products
Products for tower sites and crews that work on them, including safety equipment, tools, mounts, lighting, grounding, capstands, various locking hooks, caradinels and more.
New products
Safety equipment from DBI, Klein, Miller.
Circle 328

TPL Communications **Booth 943**
Existing products
RF power amplifiers: VHF low-band 35MHz–50MHz, high-band 136MHz–175MHz, UHF 400MHz–512MHz and 806MHz–960MHz with output to 2kW available in mobile, base station/repeater configurations; custom amplifiers available.
Circle 329 **See our ad on page 59**

TRL Technologies **Booth 679**
Existing products
Amplifiers from dc to 3GHz with output levels from 0.25W to 300W; products developed for use in cellular, paging, PCS and trunking.
Circle 330

Tricor Industries **Booth 451**
Existing products
Electrolytic grounding system (EGS) rods; Test Metic LEM; covert box.
Circle 331 **See our ad on page 77**

TX RX Systems **Booth 1022**
Existing products
Base station antennas; multicouplers; signal boosters; tower-mounted preamplifiers; cavity filters; duplexers; RF system products.
New products
800MHz tower-top amplifier 426-86A-01-18-12; TX paging filter 89-88-95482.
Circle 332 **See our ad on page 3**

Vega/Telex Signaling Products **Booth 235**
Existing products
Model C-6124 24-line control console; C-550 RP-251 adapter panel; 223C adapter panel and associated system cards; amplifier cards; audio mixer cards.
New products
Model C01610 six-line tone-remote control console; model C2000 single-line tone-remote control console.
Circle 333 **See our ad on page 10**

Veridian, Datumtech Operations **Booth 1007**
Existing products
Automatic vehicle location system; mobile data computers; intelligent data interface (IDI2); automatic collision notification system
Circle 334

Vocom Products **Booth 1001**
Existing products
Power amplifiers for the UHF, VHF and 900MHz markets.
New products
Rugged, modular designs using leading-edge technology will be unveiled with the introduction of Crescend Technologies.
Circle 335

W & W Manufacturing **Booth 225**
Existing products
Two-way radio replacement batteries; chargers; analyzer/conditioners; adapter cups for land mobile radios, cellphones, camcorders and laptops.
New products
Replacement batteries for Motorola HT750, 1250 and 1550 series; TAIT T3000II; Motorola GP68; BE EDACS Monogram.
Circle 336 **See our ads on pages 9 & 32A**

Wilson Electronics **Booth 1427**
Existing products
Cellphone signal booster.
Circle 337

Wood and Douglas **Booth 1256**
Existing products
Radio telemetry transmitters, receivers and transceivers; radio modems; data links.
Circle 338

World Tower **Booth 577**
Existing products
Drawing package on guyed and self-support towers; brochures on towers.
Circle 339

Z-Technology **Booth 871**
Existing products
R-506 digital and analog field strength meter; R-507 field strength meter with swept spectrum display.
New products
S-5007GPS field strength measurement system with GPS mapping software for digital and analog signal testing.
Circle 340 **See our ad on page 77**

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Visit us at IWCE, Booth #857

BAPCO 2000 is the exhibition and conference for everyone involved in public safety communications and information systems. It is the perfect event for key personnel to experience at first hand the latest technological advances in this dynamic industry. The networking opportunities are vast.

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MRT

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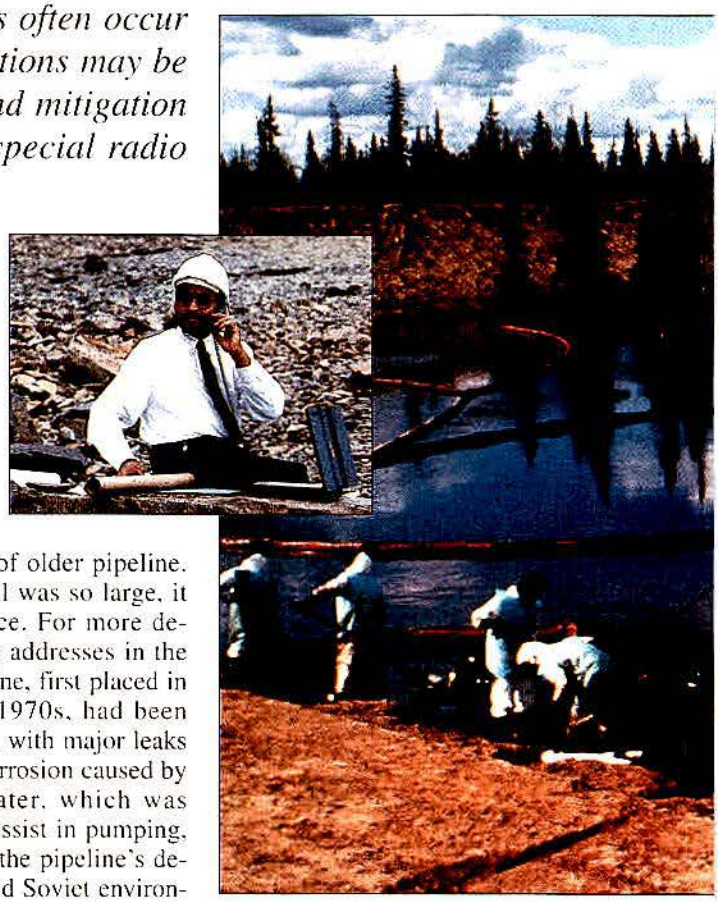
Oil on the Tundra: A sp

Industrial accidents involving natural resources often occur in rural or remote locations. Radio communications may be the only means of coordinating containment and mitigation efforts. However, the accident itself can pose special radio operations and maintenance problems.

By Donald E. Koehler



From August to September 1994, a series of massive oil pipeline leaks occurred in rural Northern Russia in an area about 1,200km due west of Finland, near the Arctic Circle. The nearest town to the spill area was Usinsk, about 30km away.

The communications requirements of the resultant containment, cleanup and mitigation activities are of interest both for the lessons learned and for planning a remote response. While the Russian pipeline leak may be unique because of its sheer size, it provides many examples and lessons. Smaller pipeline leaks occur regularly in North America and a response-communications planner or provider must understand this type of technology accident.

What happened?

The Komi spill, also known as "The Usinsk Accident," has been reported (1) as one of the worst in history, perhaps eight times greater than the EXXON Valdez tanker spill. The pipeline owner, KomiNeft (Komi Oil), local authorities and the Russian government initially tried to downplay or obscure the extent of the spill. When oil started to show up in the Barents Sea, the world community was forced to step in to control the environmental damage.

The release has been estimated as high as 200,000 metric tons of oil, found at four major points over an 18km length of older pipeline. (The scope of the spill was so large, it was visible from space. For more details, see the Web site addresses in the references.) The pipeline, first placed in service in the early 1970s, had been leaking for some time, with major leaks first noted in 1988. Corrosion caused by oxygenated river water, which was mixed into the oil to assist in pumping, was a major factor in the pipeline's deterioration. Take the old Soviet environmental attitude, bad construction techniques and then add in the general societal chaos at the collapse of the old Communist system, and you have a complete recipe for disaster.

Initial containment efforts, such as siphon dams built of sand, were only marginally successful. And, when the spring thaw hit in 1995, they failed completely. Under intense pressure from the world community, the Russians brought Western technology and a small number of American oil workers in under contract (2) to provide new cleanup technology and training on proven response techniques. The U.S. government and the World Bank (3) provided funding and survey data to address the spill problem.

Have background, will travel

How did I get involved? Before the spill, I had spent several years writing response, training and logistics support documents first as a contractor, then later as an employee, for an environmental company in Alaska. In April 1995, I was contacted by the company owner and offered a job on the spill response team as the plan writer and to provide photographic documentation. I resigned my position at the University of Alaska and traveled to Usinsk. Once at the job site, it became more of a "Swiss-army-knife" job, entailing work on LMR radio systems, making maps, fixing gas samplers, setting up computers and printers, and performing basic survey work, all as part of the total response effort.

I walked some 40km along the soiled shores of the Kolva river and feeder streams, the inland spill sites and the length of the damaged section of the pipeline—photographing and surveying the damage. It is impossible to fully describe the spill and its impact adequately in words alone. I photographed the project, people, equipment and structures, producing more than 3,000 map-indexed images. An on-site project ecological science team generated additional photo work and documentation.

Communication was provided by radios and repeaters obtained from a Canadian oil company under a subcontract. Communication back to Alaska was via INMARSAT-P phones. These units are

Wireless @ Work

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ill in the Komi Republic

Workers used hydraulically powered positive displacement pumps to remove oil. Collection efforts were coordinated with radios. INMARSAT-P phones (inset) provided links to home offices and secure fax links for contractors *(inset photo by INMARSAT)*.

worth their weight in gold for this type of operation, especially during the logistics ramp-up. The satcom radios were also critical during the bid phase when no formal contract agreements existed with Russia, and because the telephone system dates from 1917 *(honest)*. The ability to send and receive data and faxes in the field—via a laptop computer—is critical to setting up the infrastructure to support large-scale operations. It also provides a "paper trail" and reduces the potential for confusion. We used Macintosh Powerbook 180s with small printers linked together in a small LAN to handle the office chores, with the satcom link serving as a backup for critical fax documents.

Costs and funding

The Kolva River Basin Response Project was successful because it prevented further oil from reaching the Kolva, Usa and other downstream rivers. Funds that were available and were used for the project were equivalent to $23 million, with the bulk of the project work done over two summers. The EXXON Valdez cleanup, by contrast, consumed some $5 billion over several years. The Komi impact site was larger by several orders of magnitude.

The disparity in response funding levels reflects differences in government philosophy, location, physical and chemical characteristics of the oil itself and—frankly—the depth of the pockets of the pipeline company. Because KomiNeft was technically bankrupt at the time, funding was heavily dependent on sources outside of Russia.

Containment and communications

Terrestrial spills can be somewhat easier to access and control, with less impact from bad weather or access, compared to ocean tanker spills. But on a spill of this size—and in the Arctic wilderness—nothing was easy. Roads were laid out to the spill sites for construction of containment and collection infrastructure. Large amounts of the oil were simply buried in "polygons"—large, clay-lined pits near the collection points. The project's goal was to keep the oil from migrating into the ocean. Management could be performed site-by-site under local supervision.

The radio net was used primarily for safety and logistics calls. All of the radio systems used (hand-held and mobile units) were made by Motorola. Because the spill was primarily terrestrial, the work sites were well defined. Radios were used for logistics and safety/health emergencies. The radio system included a series of repeater/remote base stations. The base stations were linked back to the central control point via a UHF link. Most communication was simplex within the work site—saving money (access to a repeater) and reducing co-channel interference. The sites were separated (in some cases, by 15km). This allowed reuse of radio frequencies—again, a savings. The Radius hand-held systems worked great, taking the day-to-day beating without a glitch. The battery life was also a lifesaver because most sites did not have ac power for charging stations. We considered

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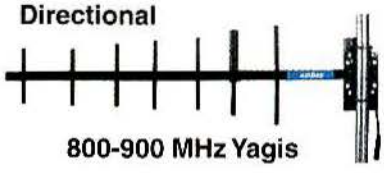

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Located about 1,100km north of Moscow, this portion of the Tigara forest is a mix of open meadows and trees. In many cases the roadbed had to be used as an oil spill containment structure, lined with Geotex fabric to protect the permafrost layer beneath.

using solar panels, but because of cost, shipping and security issues it was decided that extra batteries were the best, least-cost option.

Intrinsically safe (IS) radios were not used at the Komi site because the oil had aged over a winter. If you work on a fresh spill, or in an area involving natural gas, the safety staff should designate areas requiring IS equipment.

Waxworks in ebony

Although the oil was bad for the environment, the greater impact to the fragile Arctic ecology may have been the brine mixed with the oil to ease pumping. The oil itself is a thick, heavy (high-paraffin content) type that must be heated to pump. Once the oil left the pipeline, it essentially "froze" in place—looking like huge slabs of black candle wax. Indeed, in many areas, the oil was removed with a backhoe. The summer heat would cause it to flow again. In many areas the water had carried oil high into the trees lining the impacted streams.

If you're ever involved in a response effort like this, realize that it is *dirty* work. The radios *will* get dirty and possibly oily. Be prepared to clean and decontaminate equipment regularly. The prime contractor's safety office should provide instructions for this—or you can insist that the equipment be cleaned and decontaminated before you work on it. Be prepared to look at all sorts of odd equipment. If you are the prime electronics repair shop, you may be expected to work on a gas-sampling apparatus, a turbidity meter or some other esoteric device. Sort out *in advance* what you *will* work on and what is *out of scope*. (Workflow suggestion: Put the word out early that you *will not* touch personal radios, phones, CD players, cassette players, etc.) Portable scanners for the technicians are also useful field tools that allow them to keep tabs on what is working or not.

Impacts to the local area

The spill area is remote: thinly populated and rural. In many ways, it resembles conditions found in Alaska. The initial spill affected about 67.5 hectares of tundra; then spring floodwaters spread the oil. Scientists have established that about 2,110 hectares (1 hectare = 2.2 acres) of meadows and pastures, including reindeer grazing lands, were contaminated. In some villages, as much as 92% of all the grazing and fodder-producing land was affected. Damage to rivers, pastures and meadows seriously affects the well-being of the local residents, who depend strongly on their vegetable plots, cattle, hunting and fishing for existence. (4)

The economic impact and damage estimates were based on the officially adopted figure of 14,033 tons of oil. Overall damage was estimated at more than 311 billion rubles (about US$103 million). The officially confirmed estimate of 79,000 tons of spilled oil brought the cost of the damage to 1.5 trillion Rubles (US$495.7 billion). (5)

The difference in the estimates of the size of spill, from less than 15 kilotons to the high end of from 102 kilotons to 200 kilotons, is the difference between Russian estimates and measurements made by the U.S. EPA (6) and Canadian environmental specialists.

By contrast, the TransAlaska Pipeline System (TAPS) has operated during the same timeframe as the KomiNeft system, in a similar environment, with only two small spills, measured in *barrels* rather than tons. Both Alaskan spills were quickly contained and cleaned up,

and restoration work was initiated. Oversight and regulation provide the difference in the outcome.

Disaster team planning

Communications planners must account for the inevitable EMI/RFI and incompatibility issues that arise from too many radios and too few frequencies. Work in or around littoral (shoreline) areas brings the additional headache of coordinating marine and safety frequency usage. Preplanning and drills in your area of responsibility will help, but you must experience the incredible congestion to fully understand the frustration of radio users.

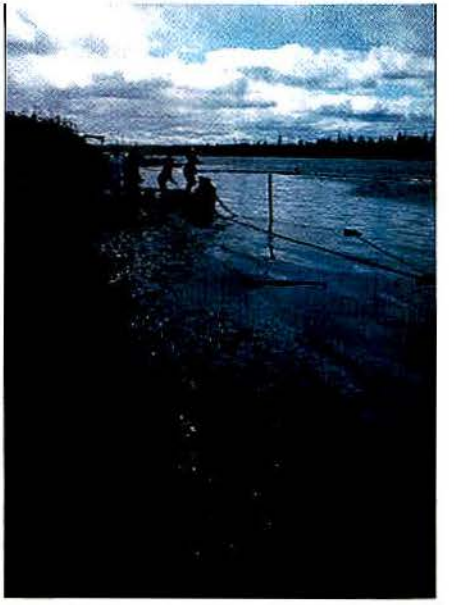
Taking the plan to the field

▶ *"Crowd control"* — The sheer number of people who respond for containment, cleanup and mitigation activities can be overwhelming. You may not be able to find a hotel or motel room for miles around your site. The rental car scene will be chaotic, as will any public transportation systems. This has been described as a "flood" of humanity. In the Komi case, several thousand people showed at the gate of the project office seeking jobs. Rental and itinerant radio systems will complicate matters. Many large clean-up projects have resorted to full-time frequency coordinators.

▶ *Resource allocations and security* — You may find yourself competing with deep-pocket government agencies or pipeline response companies for scarce resources. As silly as it may sound now, do you have enough batteries, generators and the like for operation of *at least a week* at the response site? I may seem overly sensitive about logistics, but it can be a hard lesson to learn. In Russia, for example, many of my American colleagues learned the hard way that you don't just go to the corner store for supplies.

Once in the field, you will find out just how well you planned. Extra handmics, antennas and batteries are always needed due to harsh conditions and the "Bubba factor" found on this type of project. A complete set of hand tools and several small tool boxes (one per technician, *minimum*) will allow you to respond to work on communications equipment without pulling the heavy equipment (like bulldozers and motorblades) off of the job site. A portable, trailer-mounted shelter can provide a clean, dry work area.

"Strap-hangers"—the press, protesters, job seekers and the idly curious—may play into this equation as well.



Cascading booms were used to force oil to shore on the banks of the Kolva river. Radio communications linked workers, river boats and collection barges.

How good is your security? Place the repeaters in strong, locked, portable buildings. Shop and maintenance equipment should be clearly marked and locked up.

▶ *Downwind impacts* — During the Komi cleanup, a large oil containment area was deliberately—and illegally—set afire. The smoke plume (and toxic byproducts) rose more than 8,000 feet

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Many project vehicles were coverted from Soviet military material. This ambulance had been an army 'URAL' truck. Medical service was centrally located and radio-dispatched.

and extended beyond the horizon—some 40 miles away. Your workers may be required to wear personal protective equipment (PPE). Be sure to have an initial issue on hand before you leave for the response site. This also raises the issue of mics and earpieces that can be worn and used *inside* a HAZMAT suit.

▶ *Transportation impacts* — Radio installation may be tricky, depending on the indigenous vehicles. The Russian light trucks, jeeps and vans were all 12Vdc, negative-ground power systems. The dashboards were large—and metal. Many of the heavy trucks and related pieces of heavy equipment used in the former Soviet Union are right out of *Jane's International Defense Review*. The most unusual setup we encountered was an ICBM TEL (transporter/erector/launcher) converted to carry a 25-ton construction crane. Large numbers of vehicles—from pickup trucks to 10-yard dump trucks and backhoes (including associated flatbed and tanker trucks) may also become an obstacle and cause a logistics nightmare. Do you have alternate transportation routes or bus service available for your workers? A park-and-ride scheme may be necessary.

▶ *Health impacts* — Toxic byproducts from spills or the burning of spilled material may be health hazards. Some type of employee health monitoring will be necessary if employees spend much time on site. See your local OSHA or EPA representatives for the current rules and regulations.

Becoming a resource

Remember to maintain your sense of humor, keep the radios running and work *with* the customer (the prime contractor). Spill response and cleanup management crews are a small group of people who remember who worked well "the last time." They are noted for extending an invitation to bid based on a word-of-mouth reference. Providing communications support for an accident response project can be profitable—*if* you do your homework. Success requires planning and practicing response and maintenance strategies. ■

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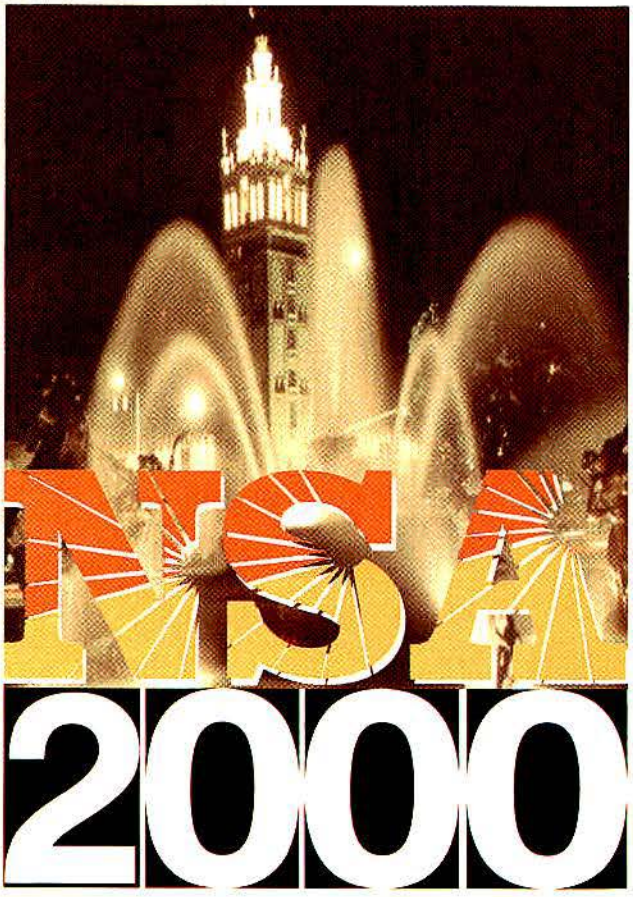

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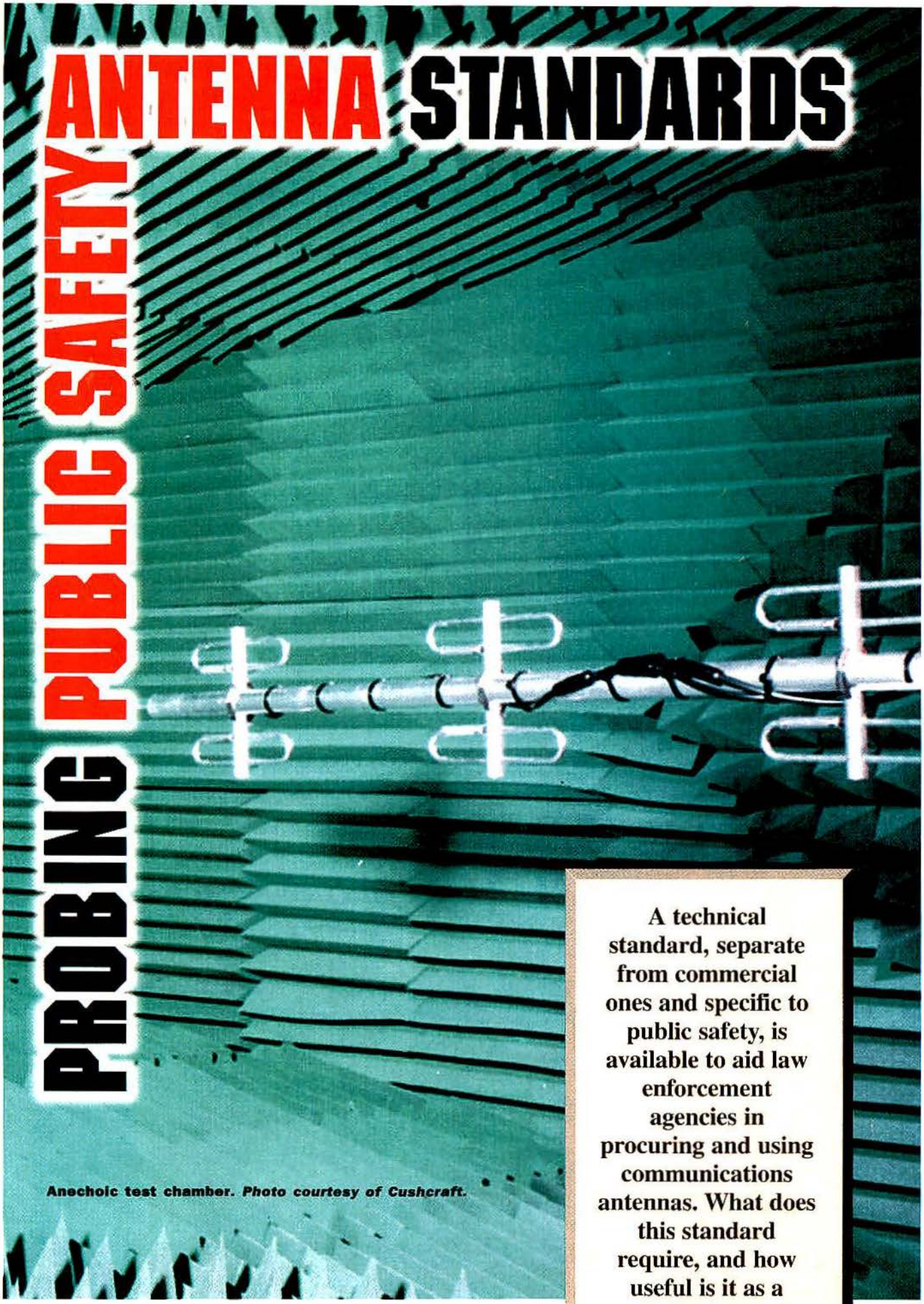

Anechoic test chamber. *Photo courtesy of Cushcraft.*

A technical standard, separate from commercial ones and specific to public safety, is available to aid law enforcement agencies in procuring and using communications antennas. What does this standard require, and how useful is it as a purchasing and operations guide?

By D. A. Keckler

A fable: An analyst comes out to a tower site to advise the manager on antenna spacing. He shimmies up the tower, unravels an old ball of string from his pocket and, like a tailor, matches the distance between the sticks with his string. When he comes back down, the manager asks "What next?" The analyst says "Well, I guess the length of the string, which gives us an estimation of the separation, and then we change the spacing accordingly. "Good grief, man," the manager cries, "In that case, why not just estimate the spacing to begin with?" The analyst shakes his head and replies, "You don't understand analysis; there has to be a standard."

Many standards apply to public safety radio. The most celebrated example in recent years is Project 25. Standards aid procurement, facilitate replacement, promote interoperability and act as quality control. The commercial minimum standard for communication antennas is TIA/EIA 329-B. One of its counterparts in the public safety realm is *NIJ Standard-0204.02: Fixed and Base Station Antennas.*

The standard[1] is one of many projects of a government program created by Congress 21 years ago to determine technology needs for justice agencies, to set technology performance standards and to distribute those results to the federal, state and local law enforcement communities. This program, the National Institute of Justice (NIJ), essentially provides impartial and free resources that a user, e.g., the communications division head of a local police department, can turn to for technical standards, reports and user guidelines.

The NIJ Standard 0204.02 for antennas, released about a year and a half ago, replaces version 0204.01, created in 1981. Its stated purpose is to "establish minimum performance

requirements and methods of test for antennas that are used at base stations or other fixed sites by law enforcement agencies." Land mobile antennas covered by the standard are those for use at VHF lowband, VHF highband, UHF and 800MHz/900MHz.

Equipment requirements

▶ *Minimum performance* — The minimum performance standards in 0204.02, meeting or exceeding TIA/EIA 329-B, include:

1. Operating at the *rated power output* with no physical damage.
2. A *radiation pattern* ±1.5dB of the specified gain for the main lobe (or full range for omnis) and ±5dB of the gain in the minor lobes.
3. A *VSWR* of 1.5 or less on all frequencies (referenced to a 50Ω system).
4. A *wind load rating* times 1.65 the values specified in Chapter 16 of the TIA/EIA-222F tower/support structure standard; or the local building code, whichever is more stringent.

▶ *User information* — To meet the standard, OEMs, system integrators or distributors must provide the antenna purchaser with information on:

- ❑ operating frequency range.
- ❑ power rating.
- ❑ relative antenna gain, in standard gain unit, over the frequency range to be used.
- ❑ polarization.
- ❑ vertical radiation pattern.
- ❑ horizontal radiation pattern.
- ❑ nominal impedance,
- ❑ VSWR over the frequency range.
- ❑ connector type.
- ❑ wind load rating and ice load rating, if applicable.
- ❑ physical dimensions.
- ❑ weight.
- ❑ material composition.
- ❑ installation, operation and maintenance instructions.
- ❑ RF radiation hazard zone at full power.
- ❑ certification of compliance with the standard.

▶ *Operating environment* — Many environmental factors can degrade the structural or electrical performance of an antenna, including its radome, insulating materials and connector. For environmental and climatic endurance, the 0204.02 standard references military standard MIL STD 210C and requires the testing methods specified in MIL STD 810E as the means for manufacturers to demonstrate compliance. It does recognize that some environmental specifications not applicable to the

Keckler is features editor.

[1]To trace where the standard comes from involves some government alphabet soup. The standard was developed at the National Institute of Standards and Technology for the Law Enforcement and Corrections Standards and Testing Program of the Office of Law Enforcement Standards (OLES). OLES is an office of the National Law Enforcement and Corrections Technology Center (NLECTC), which is a program of the Office of Science and Technology (OS&T) of the National Institute of Justice (NIJ). NIJ is the R&D section of the Office of Justice Programs (OJP), which is a branch of the U.S. Department of Justice (DOJ). Printed copies of the standard are available from the National Law Enforcement and Corrections Technology Center, P. O. Box 1160, Rockville, MD 20849-1160. The standard can also be downloaded from the Internet as a PDF file at **www. nlectc.org/pubs/#comm.**

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user's climate may be waived by the procuring agency. Other specific requirements include:

- ❑ the ability to operate under sustained temperatures as high as 43°C (110°F) and solar radiation as high as 1,120W/m^2, except in the Southwestern United States, where a more stringent temperature standard of 49°C (120°F) is applied.
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- ❑ the ability to resist moisture penetration from blowing rain at a rate of 5.9 inches/hour at 24°C (75°F) in a 35-knot wind for at least one hour.
- ❑ the ability to resist a sustained relative humidity of 100% at the high and low temperature ranges.
- ❑ the ability to resist sustained exposure to salt fog, for installations intended in coastal areas.
- ❑ the ability to withstand exposure to blowing sand, dust and snow.
- ❑ the ability, for installations in ice-prone states, to withstand a 0.75-inch-thick ice glaze at the wind load.

▶ *Radiation hazard* — Radiation hazard zones are the volume of space surrounding an antenna where its power density or field strength when operating at full power exceeds recognized specified limits. The standard points out that this is not an environmental condition, nor can it be waived in a request for proposal. The standard references ANSI/IEEE standard C95.3 (1991). (However, since the issuance of 0204.02, the OSHA and the FCC have revised minimum permissible exposure limits, and these standards should be taken into account when specifying.)

Test methodology

The detailed test methods specified in 0204.02 are mostly of interest to the OEMs, system integrators and distributors, who must certify compliance with the standard. However, a brief review of the procedures will give the procuring agent an idea of how these certifications are achieved.

▶ *Test frequencies and sites* — Three frequencies are chosen from the operating range of the antenna under test, occurring roughly at the lower, middle and upper portions of that range. For multiband antennas, each frequency band must be tested in this fashion. Outdoor test sites, or ranges, have to be open, level ground. Above ground, they have to be free of any obstruction (trees, poles overhead wires, buildings, etc.) that would interfere with an EMF for at least 50λ, or 100m, whichever is greater. Below ground, the soil has to be free of geologic peculiarities, and any buried utility lines or control cables have to be at least one foot below the surface. Elevated test ranges, to simulate mountainous conditions, have additional range design requirements. For the higher land mobile frequencies (800MHz/900MHz), indoor ranges can be used, as shown in the opening photo on page 62.

▶ *Instrumentation* — Test equipment standards include specifications for frequency stability, phase noise limits and transmitter power minimums to exceed ambient RF noise. Receivers have to have frequency stability equivalent to transmitters and must be phase-locked to them. Pattern recorders have to be accurate to ±0.2dB. Power meters must be able to measure forward and reflected power in a 50Ω to a tolerance of 5% or less. The reference antenna for measuring gain is specified as either an adjustable, λ/2 standard dipole, or an EIA standard gain antenna.

▶ *Lowband modeling* — Scale model techniques are allowed for testing VHF lowband antennas because their physical size can make getting accurate radiation pattern and gain measurements difficult on a range. Equivalents for scaling down the antennas are provided in the standard.

Procedures are also outlined for polarizing the test and source antennas through various planes of rotation and for assessing the environmental ratings previously mentioned, as shown in Figure 1 on page 65.

Practical applications of standards

Standards are generally derived in three ways. The first situation is when an OEM that has an advantage in the manufacturing process or a proprietary technology imposes a de facto standard on the industry for a component or system. If there is widespread adoption of the technology, then there is improved interoperability for all customers. The disadvantage is that customers have a sole source for replacement parts, service and resupply. The customer also may be forced to commit to an entire product line to maintain compatibility. If the line is dropped or superseded for any reason, the customer is stuck.

The second situation is when an industry or professional association acts as a clearinghouse or sponsor for standardizing the technology. Advantages are broad adoption, the creation of standard definitions, procedures and advertising guidelines, and the discourage-

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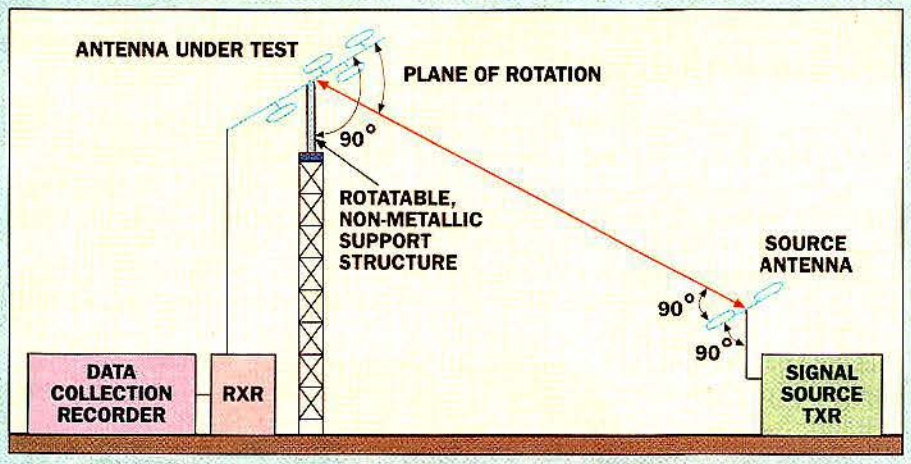

Figure 1. Example of an elevation plane radiation pattern measurement at a slant range, as described by the NIJ standard 0204.02 section on radiation pattern testing.

ment of substandard manufacturers. Disadvantages include exclusion of some ideas and technical approaches, and the onus of being non-compliant and shut out of the RFP process if you are a manufacturer with a different idea.

The third situation is where an independent or government "think tank" designs an ideal standard, which, if adhered to, would produce the best component for durability, redundancy and performance. Advantages in this case are relative freedom from commercial bias and a focus on the consumer. These standards are also usually freely distributed, as opposed to those that form a reprint profit center for an association. The disadvantage is that such standards, like isotropic antennas, are theoretical concepts. They often ignore physical—or commercial—realities.

Like the analyst in the opening fable, we can agree that the worst standard is none at all. All standards, including NIJ 0204-02, are useful tools for obtaining quality, durable equipment. However, there are other practical considerations when procuring equipment for a public safety agency: budget and cost, warranties, maintenance costs and specific operating conditions in the agency's environment. Encompassing all of these is the reality that communications systems generally require a holistic approach. That is, they are purchased *as* a system.

In the public safety arena, only the largest city, state and federal agencies buy directly from manufacturers and have the luxury of dictating a tight set of standards. Most systems for police, fire and EMS at the local level are purchased from a trusted or familiar radio dealership with which there is an ongoing relationship. Superseding product quality, service and support, the main factor in this relationship is usually cost.

The NIJ standard draws heavily on other standards created by the Institute of Electrical and Electronics Engineers (IEEE), the Electronics Industry Association/Telecommunications Industry Association (EIA/TIA), the American National Standards Institute (ANSI) and the U.S. military, acting separately or cooperatively. In addition to these bodies, there are test procedures and test ranges maintained by individual manufacturers, the National Institute of Standards (NIST), the FCC and the National Telecommunications Information Administration (NTIA). (The NTIA just added an advanced test bed for smart antennas at its Institute for Telecommunications Sciences [ITS] in Boulder, CO, last November.)

With all these sources of information, is there a demonstrated need for separate standards specific to the public safety market? Antennas are "transparent equipment" to most radio systems; that is, one manufacturer's antenna will work with 50 different manufacturers' base stations. However, part of the NIJ mission has been to raise the level of technical awareness in the public safety communications arena. Many radio managers and technicians come into the job with little experience in land mobile. Concepts like wind loading and radiation patterns may be new to those with only dispatch, computer or digital backgrounds. Distribution of this type of information can help them make more informed equipment choices. There are also mission-related differences between public safety systems and commercial or private radio.

To explore this issue of separate public safety communications standards further, an expanded version of this article is available on *MRT's* Web site, **www.mrtmag.com**. It includes assessments from public safety procurement officers, manufacturing engineers and those who create technical standards. ■

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SCADA Lives!

A favorable regulatory climate and improving technology pump new life into wireless monitoring and control.

By the *MRT* Staff

Regulatory changes and technical advances can be expected to breathe new life into the arena of supervisory control and data acquisition (SCADA) equipment in the coming decade. At the same time, more emphasis will be placed on increasing productivity and reducing overhead by moving from copper- and fiber-based SCADA systems to wireless over licensed and unlicensed spectrum.

Adding fixed to mobile

Although SCADA communications are generally fixed, and not within the realm of "mobile" radio technology, the installation, maintenance and supervision of such systems often falls into the bailiwick of the industrial communications systems manager. SCADA devices are used in security, environmental control and industrial applications, such as oil and gas production and distribution. Utilities use SCADA on radio frequencies to automatically monitor power plants, pipelines and distribution centers. One example would be to display the status of lower-voltage substations. SCADA applications reduce personnel needs for onsite monitoring, reduce power consumption for control devices and provide faster detection and correction of errors in systems they monitor.

A particularly informative SCADA education track is featured each year at the ENTELEC energy communications conference. This year's conference takes place in Dallas later this month. *(See the box on the opposite page.)*

SCADA systems consist of four major parts: 1) a human machine interface (HMI), which is a computer program that requests remote sensor data; 2) the communications infrastructure, wired or wireless; 3) remote terminal devices (RTUs) that provide input/output capabilities; and 4) an application for receiving and displaying information from the polled sensors that may also be used to send commands, such as "close valve 12," to a remote site.

From copper to the air

Metric Systems President William Brown, writing in the January issue of *MRT's* sister publication, *RF Design*, noted that there is an ongoing transition from copper-based to wireless-based control systems that may come to account for 20% to 50% of private networking. Brown portended that wireless will become the most reliable and least expensive choice for industrial automation, with full duplex throughputs of data becoming cost-equivalent to 9600-baud narrowband copper and fiber systems. According to Brown, four change agents affect industrial automation: 1) a greater comfort factor and knowledge base among information technology managers; 2) "aggressive rejection of proprietary products or communications schemes"; 3) the advent of more open architecture systems; and 4) FCC actions to supply more bandwidth.

Regulatory climate

In the latter case, utility and energy communications received a boost in January when the FCC announced it will resume licensing for multiple address systems (MAS) in the 900MHz bands. MAS historically has been used for alarm, control, polling and status reporting communications in the power, petroleum, security and paging industries. The commission created a three-pool licensing approach for the 932/941MHz MAS band. One pool of 20 paired channels will be auctioned. However, one pool of five paired channels will be licensed site by site to government and public safety entities, and one pool of 15 paired channels will be licensed site by site to public safety and private systems users such as utilities, pipelines and other infrastructure industries. The FCC had been examining a new licensing approach since early in 1997, and then had frozen licensing in July of last year. Therefore, the long-awaited release of the spectrum was heralded by industry trade groups.

The Public Safety and Private Wireless (PS&PW) Division of the FCC's Wireless Telecommunication Bureau has also been a friend to SCADA users in recent months. In January, the division allowed Tenneco Communications to convert developmental licenses for 10kHz "sliver" channels in the 30MHz band into regular five-year licenses. The licenses are used to provide gas-metering SCADA for El Paso's Tennessee Gas Pipeline System. Channels in the higher-frequency MAS band were

either unavailable or ill-suited to propagation over the terrain, and using 450MHz-470MHz (if available) would have been on a secondary basis and had the potential for interference. Tenneco opted for the 30MHz approach, and the FCC acceded to the request.

In October, in adjudicating an interference dispute, the PS&PW Division supported a Vermont water district's assertion of the primacy of its SCADA monitoring use of 452MHz over the same-band presence of an improperly licensed private station. A footnote to this case is the position taken by the Industrial Telecommunications Association (ITA) in its role of resolving interference complaints in cooperation with the FCC's Compliance and Information Bureau (now the Enforcement Bureau). ITA held that SCADA transmissions of continuous data without a monitoring capability place those SCADA operations on a secondary basis. The private station was shut down by the FCC because it was operating on an improper license transfer, but nothing in the PS&PW Division's decision contradicted the ITA position on status.

SCADA at ENTELEC 2000

As of press time, the following papers on SCADA systems were scheduled to be presented at the ENTELEC energy telecommunications conference at the Dallas Convention Center, Dallas, on March 19-22. For further information, see the ENTELEC Web site at www.entelec.org.

- ❑ **"The challenge of SCADA: The application of information technology in pipeline systems"**
  Presenters: Martin W. Mans and Herwig S. Mlaker, PLE Germany
- ❑ **"SCADA outsourcing—A business case"**
  Presenter: Gerald E. Snow, UTSI International
- ❑ **"What Drives a SCADA system upgrade?"**
  Presenter: Al Senftleber, Senftleber & Associates
- ❑ **"Implementation of the Web server for process control"**
  Presenters: Irwan T. Tantu and Ken Booth
- ❑ **"TECO Peoples Gas SCADA replacement project"**
  Presenters: Bill Cooper, Matrikon Consulting, and Todd Weidley, TECO Peoples Gas
- ❑ **"Designing a cost-effective SCADA system"**
  Presenters: Janice Hungerford and Danetta York, ProSoft Technology
- ❑ **"Success of a self-built SCADA system: Walking away from the traditional approach"**
  Presenter: Glenn Stoner, Colorado Springs Utilities
- ❑ **"Transform your SCADA department from a cost center into a profit center"**
  Presenter: Duane P. Clementson, UTSI International
- ❑ **"Wireless SCADA system design considerations"**
  Presenter: Ernest J. Zingleman, Dataradio COR
- ❑ **"Integrating security and access control for remote locations with the SCADA host"**
  Steve Nibblelink, Honeywell
- ❑ **"Qualifying SCADA personnel for OPS Rule 49 CFR Part 195"**
  Presenter: Duane P. Clementson, UTSI International
- ❑ **"Encryption provides low-cost SCADA operating security"**
  Presenters: John A. Kinast and William F. Rush Jr., Institute of Gas Technology

New approaches

The SCADA marketplace is becoming both a land of opportunity and more tightly focused. More than 400 suppliers deal with some aspect of SCADA software or instrumentation. At the same time, established firms are recombining into stronger entities, such as the 1997 incorporation of Johnson Data Telemetry into Dataradio. The merger was rechristened as Dataradio COR (for Connectivity Over Radio) in 1999 and led to the release of RF modules the size of business cards that include surface acoustic wave (SAW) filter designs.

Suppliers are ramping up new software designs targeted at dispatch centers and working on ways to incorporate SCADA data into larger corporate information technology (IT) networks. Internet protocol (IP) over wireless will therefore continue to be a hot topic. Emphasis will be placed on making SCADA data available to these networks in real time. And, like all IT systems, protection from interference and security for SCADA communications will be primary considerations.

SCADA users are finding a shrinking upgrade cycle as well. Duane Clementson, vice president of operations for UTSI International, Friendswood, TX, has estimated that the upgrade cycle has fallen from 15 to three years.

Improvements in wireless technology, opportunities for new bandwidth and information systems convergence are breathing new life into SCADA. ■

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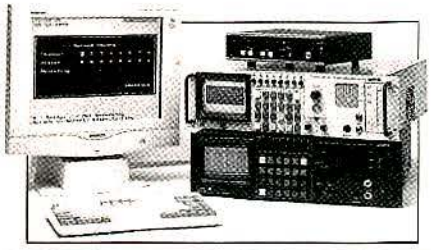

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Transcrypt settles, approved by court

A federal court has granted Transcrypt International, Lincoln, NE, preliminary approval of a settlement of pending stockholder class action suits against the company and against some current and former officers. Under the settlement, Transcrypt will distribute to class members and their lawyers 4,460,000 shares of Transcrypt common stock and an amount between $3.85 million and $8.85 million, to be paid by Transcrypt's insurance carriers (depending on the outcome of an arbitration between plaintiffs and one of the insurance carriers).

Transcrypt would also pay $2 million to the stockholders if there is a purchase of a majority of Transcrypt by acquisition or merger before Jan. 1, 2001. The settlement is subject to a number of contingencies, including final court approval of the settlement.

"We are pleased that we have reached another milestone in finalizing the company's class action lawsuits," said Michael Jalbert, Transcrypt's chairman.

Comsearch opens new western office

Comsearch, Reston, VA, has opened an office in Denver to meet increased demand for microwave design and frequency coordination services

Heading the office is Douglas Erbeck, formally with Western TeleCommunications.

"Doug has been involved in the design, coordination and licensing of microwave and satellite systems for the past 28 years," said Chris Hardy, vice president of Engineering Services at Comsearch. "He brings invaluable industry experience to Comsearch, and more importantly, to customers located in our Western region."

Comsearch clients may continue to use their present account representative, or call Erbeck for local support. Call 303-400-4056; or fax 303-400-4576; email **comsdenver@home.com.**

Dealers can overcome 'confusion' to raise radio sales

Quality Mobile Communications, a 24-year old sales and service shop based in Vancouver, WA, primarily services the wireless communication and information needs of business and industrial clients throughout the greater Portland, OR, and southwest Washington markets.

Quality's sales efforts focus on UHF and 220MHz trunking products for those applications where private, wide-area coverage, voice and data fleet dispatch communication capabilities are needed and on conventional UHF/VHF products for on-site or in-plant communication applications. Quality also sells and services systems for SCADA, telemetry, vehicle location and wireless data.

Kenwood radios

Quality's General Manager Nick Ruark cites "market confusion" as a factor limiting greater use of dispatch two-way radio.

"With all the advertising and publicity spewed forth by the cellular and PCS folks, along with a variety of other emerging wireless technologies to choose from, many business owners are totally confused about which is the "right" or best "tool" for their particular needs," Ruark said.

"Most businesses don't have the time, staff or expertise to sort through all the hype and marketing rhetoric; neither do they take the time to determine just what kind of communication tools they really need. Consequently, the first thing many buyers do is call a cellular provider. Obviously, the buyer isn't going to hear very much about the benefits of dispatch two-way radio communications from the cellular folks. That's unfortunate, because two-way radio is still the most cost-effective, one-to-many voice communication tool available for managing and coordinating mobile work groups," Ruark said.

"It amazes me that businesses who use Nextel's dispatch service are willing to pay three to five times more for that service than they would if they were using two-way radio dispatch. That's impressive. I wonder if Nextel users actually get three to five times the value for the high per-unit monthly cost of the service?

"I think many who use Nextel have been led to believe that it's the only tool that provides them two-way radio service. This mistaken belief stems from the manner in which Nextel originally established its markets and how they sell the product. What has happened to integrity and ethics in this industry, anyway?

"If I were to treat my clients the way Nextel treated its customers during that time, I'd be out of business. Yes, I have an attitude about Nextel. I have no use for Nextel and I will not sell or recommend their product or service. That may be a business mistake, but my company has survived and prospered by placing customers' needs first and by being honest with them. My company does not sell on hype nor will it falsely promote a product or service. Most clients respect my feelings after hearing the whole Nextel story.

"I believe dispatch two-way radio has its proper place in the wireless world, and Nextel has its place," Ruark concluded.

Quality competes with seven other two-way radio shops in the Portland area, including at least two Motorola shops, several other independent dealers, Nextel, and two cellular and three PCS networks. Ruark noted that several clients also have reported receiving offers of two-way radio equipment via the Internet at lowball prices.

Kenwood is Quality's primary land-mobile radio product line, with Vertex and Radius filling in the gaps. Ruark estimated that his company sells a few hundred radios per year, with handhelds becoming increasingly popular with his clients. Many clients are also looking closely at vehicle location and fleet management systems.

Quality's products and services are promoted primarily by word-of-mouth referrals, through yellow page directory advertising and with a Web site, **www.qualitymobile.com,** that Ruark created as another way to reach potential customers within his market area.

"We believe the Web site will help us introduce new wireless communication and information products and services to our market in a more cost-effective, timely, and professional manner" Ruark said. *DB*

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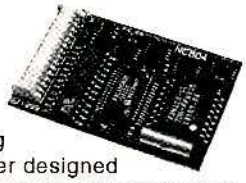

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News Notes

Sierra Wireless, Vancouver, British Columbia, will supply digital CDMA PC cards to **Sprint PCS,** Kansas City, MO. The cards will fit into a standard Type II slot on a laptop or other hand-held computing device. "Since launching the Sprint PCS Clear Wireless Workplace in June 1999, we continue to harness opportunities that add clear value to our voice and data portfolio," said **Jay Highley,** vice president, Business Customer Unit for Sprint PCS. ... **Berkeley Varitronics Systems,** Metuchen, NJ, has received an order from **Nextel Communications**, Dallas, for Gator Class A transmitters. The units will be customized for IDEN channelization. Berkeley has also received orders for the ISM Gator Class A transmitter and the ISM Fox hand-held strength meter from the **Georgia Institute of Technology** to allow students to research propagation of RF signals. ... Transport Logistics, Manchester, CT, has purchased Fleet Advisor, Clemmons, NC-based **Eaton's** transportation logistics system. "We're confident in this system and in what it will do to reduce our operating costs," **Mike Bonsignore,** vice president of Transport Logistics, said. ... **EFJohnson,** Waseca, MN, has received an add-on order totaling $554,000 from Maui County, HI, to expand the public safety system currently being installed. This order will bring the total value of the system to $2.7 million. The 800MHz Multinet trunked radio system provides seamless wide-area communications to all Maui County departments across Maui, Lanai and Molokai islands. EFJohnson also won an order from Clay County, FL, for a $1.3 million order for a microwave system to be used with the public safety radio system being installed. ... **Nortel Networks,** Brampton, Ontario, and **Harris,** Melbourne, FL, will use **EDX Engineering's** Signalpro, together with its Network Design Module for design and planning of broadband systems. ... **Decibel Products, Dallas,** will provide PCS antennas and wireless equipment to **Sprint PCS** for its Phase II build-out now in progress. ... **SEA,** Mountlake Terrace, WA, has shipped 17 channels of base station equipment as the first portion of a planned network to be installed throughout Georgia, Alabama and Florida, using spectrum in the 220MHz service. The network is the result of joint efforts of the **SMR Advisory Group,** Ft. Lauderdale, FL, and **GEMC 220,** a group of electric companies. The network will also include **Smartlink** network switches. **Bob Wise,** regional sales manager for Smartlink, said, "This joint effort is an important step in fully developing the potential of the 220MHz service and its ability to provide a simpler but substantially less expensive alternative to **Nextel.**" ... **@Road,** Fremont, CA, has signed a contract with **Mission Linen**, Santa Barbara, for the Internet-based Fleetasap fleet management service. "This system will give us more knowledge about where our trucks are and better control over routing," said **Dan Gallagher,** vice president of sales and marketing for Mission Linen. ... **Connectel,** North Carolina, and **Becker Avionics,** Miami, are incorporating **Fylde Microsystems'** MPT 1327 trunking infrastructure into Becker's portfolio of systems products. ... The state of Connecticut has activated its new $47 million **Motorola** 800MHz digital Astro Smartzone voice and Private Datatac 19.2 RD-LAP wireless data communications systems. The state has also completed the first phase of the system's installation that will provide communications support for the Connecticut State Police Troops G, A and I in the southwestern portion of the state. "Connecticut has led the way in developing public safety communications through the use of high technology—initially in the 1940s as the first state to install a statewide communications system," said Gov. **John G. Rowland**. ... Clermont County, OH, held groundbreaking ceremonies in November 1999 for the county's new **Motorola** $16 million wireless communications system. The system includes an 800MHz Astro Smartzone trunked two-way radio system, a Private Datatac wireless data system and an alphanumeric paging system. "The wireless mobile data system will enable officers for the first time to access databases, receive reports and create and file incident reports from terminals mounted in their vehicles," said County Commissioner **Richard Martin.** ... **Dataradio,** Atlanta, has installed a dedicated mobile data network for the Baton Rouge Police Department, providing the department with in-vehicle computing capabilities and automatic vehicle location. ... **BearCom Group,** Dallas, has acquired Electromatic, Portland, OR, as part of a strategy to provide a worldwide network of local sales and support. Electromatic is a **Motorola** dealer and MSS. It will operate under the name of BearCom and will be managed by **Howard Stuttman** of BearCom and **Todd Gydesen** of Electromatic. ... **Andrew,** Orland Park, IL, has acquired **Conifer,** Burlington, IA, a privately owned company that designs and manufactures multichannel, multipoint distribution service subscriber products, wireless LAN equipment and direct broadcast satellite accessories. ... **Arch Communications Group,** Westborough, MA, and **Paging Network,** Dallas, have agreed to a merger to combine PageNet's wireless network and products with Arch's nationwide accounts and sales presence. ... **FP-WJ Acquisition,** Foster City, CA, will acquire **Watkins-Johnson,** Palo Alto, CA, in a recapitalization merger transaction. FP-WJ is a new company formed by certain investment funds managed by **Fox Paine & Company.** ... **Gamber-Johnson,** Stevens Point, WI, has become a limited liability corporation. Gamber-Johnson has operated as a division of **Larsen Electronics,** Vancouver, WA, for the past 17 years. Larsen was recently purchased by **Radiall,** Paris. However, Gamber-Johnson was retained by the original investment group.

BT contracts IFR Systems for services

IFR Systems, Wichita, KS, has won a three-year contract from British Telecommunications (BT) valued at $8.1 million to supply calibration and maintenance services for BT's electronic test equipment used in field and laboratory applications throughout the United Kingdom.

"This new contract represents a substantial expansion of our long-standing relationship with BT," said Michael McCreary, director of operations for IFR in the UK. "As BT's primary service vendor, IFR will be responsible for calibration and maintenance of telecommunications test equipment manufactured by IFR as well as third parties."

Datamarine radio backlog grows

Thompson

Datamarine International, Mountlake Terrace, WA, announced on Feb. 1 that it has a backlog of $1.2 million in orders for 3,000 units of its model SEA-604 220MHz mobile radio. The company is developing software for the radio that will allow its use for wide-area networking using LTR-Net signaling.

"We are very encouraged by this growing awareness of the advantages of the 220MHz service, both economically, as well as from a radio performance standpoint," said company president David Thompson.

Maxon America sales goes independent

Maxon America's sales and marketing division is under new ownership. The new company, named Topaz3, will have the exclusive license for Maxon branded commercial two-way radio communications equipment.

Operating as an independent entity, Topaz3 will continue to grow the Maxon brand through expanded channels of distribution. The new company also will have a more proactive role in product line expansion and will retain tech support and inventory controls.

"This is an exciting time for both companies as we enter this new era," said Dan Devling, Topaz3 president. "Topaz3 is able to bring the Maxon brand to markets where we previously had limited or no distribution."

Memphis PD chooses Vision software

The Memphis, TN, Police Department has signed a $3.5 million contract to install new records management system (RMS) software. The software will be provided by Vision Software, Castle Hayne, NC, as part of its integrated Public Safety Suite of products. The new system operates on a Microsoft WindowsNT platform.

Memphis implemented Vision Software's wireless information system, Visionmobile, in April 1999. This system will fully integrate with Visionrms. Installed on laptop computers, Visionmobile enables officers to run NCIC and Visionrms queries, reducing reliance on telecommunications and increasing the speed in which data can be processed and accessed. The department plans to operate and maintain a multi-jurisdictional database for law enforcement agencies in Tennessee, Arkansas and Mississippi.

Vision Software will install RMS on more than 1,000 workstations. With two facilities slated to open in the next three years, more workstations may be added to accommodate the growing department.

Scala changes name to Kathrein, Scala division

Scala Electronic, Eugene, OR, has changed its name to Kathrein, Scala Division. In announcing the change, company President Manfred Meunzel, said, "We joined the Kathrein group of companies in 1988. At that time, we felt that the original Scala name had valuable equity. [We didn't] change the name until we had effectively established our connection with Kathrein. We are confident that we are at that point, and are ready for the name transition."

Kathrein-Werke, KG, based in Germany, develops and markets telecommunications equipment, including a complete line of telephones and an array of antennas for broadcast and mobile communications. Kathrein, Scala Division will continue to specialize in design and application engineering, the manufacturing of its line of antenna systems and follow-up service and support.

The headquarters for the division will remain in Medford, OR.

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FCC Notes

Filling long-empty shoes

A long-term vacancy in the Public Safety and Private Wireless Division of the Wireless Telecommunication Bureau was finally filled in December with the appointment of Jeanne Kowalski as deputy chief (public safety). Kowalski was formerly a senior regulations analyst with the U.S. Department of Transportation. Previously, she was a staff advisor and a congressional liaison at the Interstate Commerce Commission. Kowalski also has worked in the private sector as a legislative affairs representative for Southern Pacific Communications.

Another position filled at the same time was division deputy chief (legal). The new deputy chief, Ramona E. Melson, was chief legal counsel to the division chief as well as the branch chief of the Policy and Rules Branch in the Commercial Wireless Division. Melson has also served as a senior attorney in both the Legal Branch of the Commercial Wireless Division and the Policy and Rules Division of the Mass Media Bureau.

Public safety spectrum efficiency

At a mid-January meeting of the Public Safety National Coordinating Committtee, WTB Chief Thomas Sugrue told attendees that "Spectrum efficiency, speed of deployment and cost" would be examined when the FCC evaluates the NCC preliminary recommendations, scheduled to be presented on Feb. 25.

"... (I)f the demand for public safety channels continues at the current rate ... the entire 24MHz could be quickly swallowed up unless we adopt rules to ensure that it will be used efficiently and wisely," Sugrue said.

The NCC was set up by the FCC to gather public safety community comments on regulation of the new 700MHz public safety band, with an emphasis on interoperability considerations. In addition to the FCC, the NCC is sponsored by NTIA, the DOJ, FEMA and the Treasury Department.

Sugrue cautioned against interpreting the initial standards that the NCC recommends as final standards. "... We think that doing so could send the signal that this is 'as far as we go'—that the task of considering technical standards is over and will come to a full stop as soon as the initial recommendations are made. I think that would be unfortunate and unnecessary," Sugrue said.

"On the other hand, I've heard concerns that if the initial recommendation is not characterized as a final one, we will have only an interim standard that could change substantially when final rules are put into place," Sugrue said. "The argument goes that, if the NCC recommendation only results in interim rules, then the 700MHz spectrum will not be used. Public safety licensees would be reluctant to buy interim standard radios that could be made obsolete if the rules changed. Manufacturers would be unlikely to spend research and development money to build interim standard radios that would have to be redesigned in a few years."

Dataradio petitions for quicker access

In a related action, Dataradio, Atlanta, petitioned the FCC in January to waive 700MHz rules (Section 90.547) requiring that all narrowband public safety radios for that band be capable of operating on any nationwide narrowband interoperability channels. Dataradio's petition said that interoperability channels account for only about 10% of the 700MHz channel allocation. The company said a waiver would prevent general use 700MHz channels from being held hostage while interoperability standards are debated.

It's been a long, cold, lonely winter

In mid-January the FCC lifted the freeze on licensing for multiple address systems (MAS) in the 900MHz bands. A Report and Order in Docket 97-81 outlines new licensing and auction rules. Three pools of 20, five and 15 paired channels were created for the 934MHz/941MHz MAS band. The first pool will be licensed via auctions. The other pools will be licensed site-by-site to government and public safety agencies and to "private internal" services, including utilities and pipelines. ■

UTC launches critical communications coalition

The United Telecom Council (UTC), Washington, announced the formation of the Critical Infrastructure Communications Coalition (CICC), on Feb. 4.

The CICC, which held its first meeting in early February at the UTC headquarters, will serve as a forum to address telecommunications and information technology issues affecting organizations involved in the provision of energy, natural gas, water, transportation or other essential public services.

"The goal of the CICC is to create a favorable regulatory environment that promotes the telecommunications and information technology capabilities necessary to protect and maintain the nation's critical infrastructure," said UTC President Bill Moroney.

"The CICC will strive to enhance the awareness of government agencies of the unique communications needs of CICC members," Moroney said. "The coalition will also coordinate efforts to further equitable access to spectrum for the internal communications of coalition members."

Membership in the CICC will be limited to industry trade associations. The companies that attended the initial meeting of the CICC were the American Gas Association, the American Petroleum Institute, the American Public Power Association, the American Water Works Association, the Association of American Railroads, the Association of Oil Pipe Lines, the Edison Electric Institute, the Interstate Natural Gas Association of America, the National Association of Water Companies and the United Telecom Council. UTC will serve as the CICC administrator.

Richard Rohn retires from Rohn Industries

After 37 years with the company founded by his father, Richard L. Rohn has retired from Rohn Industries, Peoria, IL. Rohn was president of the company's Shelter Division.

Brian B. Pemberton, the company president, said, "Richard has played an important role in building Rohn's shelter division. On behalf of the board of directors and entire management team, I would like to personally thank him for 37 years of hard work and dedication to the company that his father founded."

Horace Ward, plant manager for the Shelter Division, will assume operational responsibility for the division.

Fluke buys WWG's non-core businesses

Wavetek Wandel Goltermann (WWG) has sold its Precision Measurement Division in Norwich, UK, and its Test Tools product line, based in San Diego, to Fluke of Everett, WA. According to WWG, the sale is part of its effort to streamline business and expand core competencies in communication test equipment.

"Because our company's focus and resources are 90% in communications test, we felt that our precision measurement test and tools products were not in the right environment for optimal growth," said Peter Wagner, WWG president. "Both businesses will complement Fluke's test-equipment portfolio."

Fluke has purchased the entirety of the Precision Measurement Division and will maintain the facility in Norwich, UK. All employees are transferring with the sale. Colin Ross, current general manager, will retain his role. The division will become part of Fluke's Calibration Business Unit in its Industrial Group Division.

Trident licenses NTS protocol to Motorola

Motorola, Schaumburg, IL, has received a license for Trident Micro Systems' Passport protocol for use in it's two-way products. This initiative will expand Motorola's UHF trunking portfolio to include products serving wide-area dispatch needs for small networks. Motorola's Passport product offering will include UHF band (403MHz–512MHz) portable and mobile two-way radios.

Passport is a trunking protocol developed by Arden, NC-based Trident that provides wide-area coverage and offers users and system owners several enhanced features, including:

- ❑ seamless roaming with automatic registration and de-registration between sites.
- ❑ piracy and cloning protection through electronic serial numbers.
- ❑ system migration path—Passport operates on Trident's network trunking system infrastructure (NTS), which also is compatible with radios and systems operating on the LTR protocol. The NTS infrastructure has been designed to support migration to future digital technologies.

In the test equipment market, Motorola's Commercial, Government and Industrial Solutions Sector has agreed to license its Smartnet and Smartzone trunking protocol to IFR Systems, Wichita, KS. The agreement enables IFR to provide test equipment for this wide range of systems. IFR will be able to support the analog systems that are a part of the backward compatibility requirement established in the user needs for the Project 25 standards. It will also develop and implement the Smartnet and Smartzone trunking protocols into its next-generation test products for digital systems.

Transcrypt sells Waseca facility

Transcrypt International, Lincoln, has announced the sale and leaseback of its Waseca, MN, facility for about $2.75 million. The lease is for a period of five years, and EFJohnson will occupy 132,000 square feet of the 252,000 square foot facility. Other tenants currently occupy the balance of the space.

Mike Jalbert, chairman of Transcrypt, said, "Our company continues to be focused on profitability and growth and did not see any benefit in owning real estate and acting a landlord. Our best use of cash if for the growth of our business."

NHRA chooses Racing Communications, Vertex

Racing Communications, Marrietta, GA, has been named the Official Radio Communications Company of the National Hot Rod Association, its six owned-and-operated drag racing facilities and the NHRA Safety Safari. In a joint announcement, the Vertex Standard was named the Official Radio of the NHRA.

In the multimillion-dollar, five-year agreement, Racing Communications will supply hand-held radios, headsets, mobile units, ancillary products, base radios, antennas, on-site setup and support for the 23 NHRA Winston Drag Racing Series national events, the Winston Showdown and the 43 NHRA Federal-Mogul Drag Racing Series events through the 2004 season.

Racing Communications will also have a major presence at the NHRA Manufacturers Midway, providing on-site sales, rentals and service of scanners, headsets and communications needs for NHRA race teams and fans.

Global Dispatch adds public safety specialists

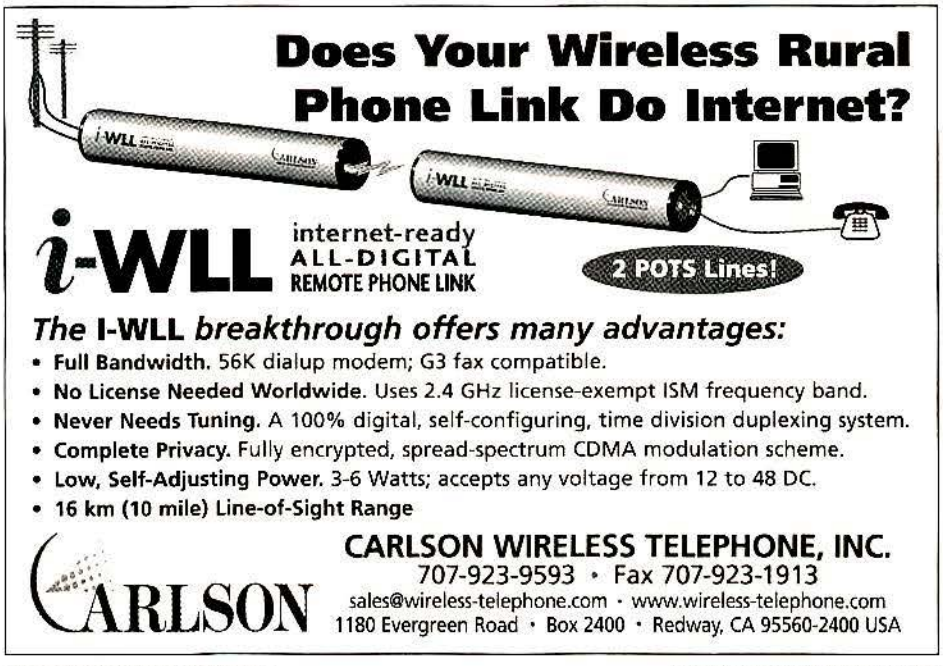
Global Dispatch Technology, Oklahoma City, has hired three prominent members of the public safety industry to handle regional sales and special projects. The new team includes David E. Hanks, special projects coordinator; David B. McClaren, central region account manager; and Michael M. Woods, C.C.A., western region account manager.

"Global Dispatch believes in hiring individuals that understand the public safety industry rather than hire those that just understand sales," said Doug Garber, chief operating officer of Global Dispatch. "We want law enforcement professional that know how to talk to law enforcement professionals."

Hanks graduated from the Federal Bureau of Investigation's National Police Academy in Virginia. His 30 years of experience in public safety include working for the Irving, TX, Police Department as captain of technical services, special operations, patrol and criminal investigation. He also served as a lieutenant and police officer at Irving PD.

McClaren has more than 15 years of private investigation experience and about seven years in law enforcement/public safety. He has served as a criminal investigator for the McLennan County Sheriff's Department and as a parole officer for the Texas Board of Pardons and Parole.

Woods is a retired lieutenant of the Los Angeles County Sheriff's Department, bringing about 30 years of law enforcement experience to the company.



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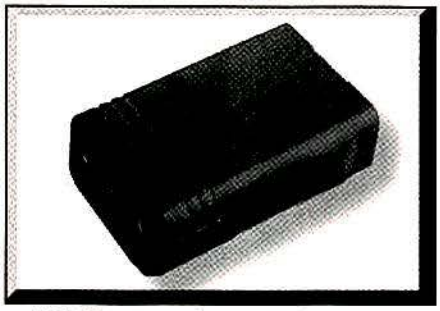
Portable batteries

Replacement battery fits Motorola GP68



W&W Manufacturing's Motorola GP68 replacement battery is available in the following capacities: The WC-037C-4000B is a NiCd battery rated at 7.2V at 1,200mAh; the WC-037C1-4000B(S) is also a NiCd and specified as 1.2V at 1,500mAh. The HC-037C1M-4000B(S)M is a NiMH battery with 7.2V at 2,100mAh.

Circle (351) on Fast Fact Card

Battery offers safety vents

Alexander Technologies' HNN-9049A replacement battery is for Motorola Radius P1225 radios. The battery has an ultrasonically sealed housing and is built new to meet or exceed OEM specifications. The nominal voltage is 7.5V with a capacity of 12,000mAh. Each cell is safety-vented to provide rapid release in high-pressure situations.

Circle (352) on Fast Fact Card

Battery works with Saber radio

The M4595H from **Multiplier Industries** is a rechargeable replacement battery for the Motorola Saber radio. The nickel-metal hydride (NiMH) battery is rated at 7.5V and 2,700mAh capacity. It is designed for an exact fit to the radio and charger.

Circle (353) on Fast Fact Card

Batteries support Kenwood, Vertex radios

JBRO Batteries' land mobile radio replacement battery line includes the new JB-KNB17, which works in Kenwood TK280, TK290 and TK380 radios. The battery measures 4.37" × 2.28" × 0.79". The voltage is the standard 7.5V, with a capacity of 1,500mAh. The JB-FNB47 battery for the Yaesu Vertex VX10 has a capacity of 1,200mAh and is rated at 7.2V. Its dimensions are 3.875" × 0.875" × 2.25".

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READERS' CHOICE

Of the new products in the July 1999 issue, this one generated the biggest reader response. For more information on this product, circle the corresponding Fast Fact number on the card found in the back of this issue, and mail the card to us.

Digital modem links various devices

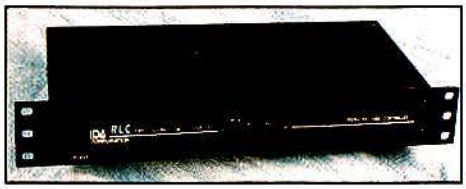
The **Aerotron-Repco Systems** Bluestreak is a high-speed digital communications modem capable of linking various electronic devices.

Because it uses RF spread-spectrum technology, no FCC license is needed. Plug in the unit and immediately establish a data link. The unit can be configured for point-to-point, point-to-multipoint and broadcast group operation. In broadcast mode, all units within the group receive messages from one unit within the group. Repeaters can be configured for broadcast groups as well. The fast setup feature allows the user to press a button on the modem to initiate handshake operations with other modems. Data transfer between modems includes compatible communication parameters and address information. After fast setup, the modems can be placed in service and do not require any additional configuration.

Circle (500) on Fast Fact Card

LTR trunking panel prevents interference

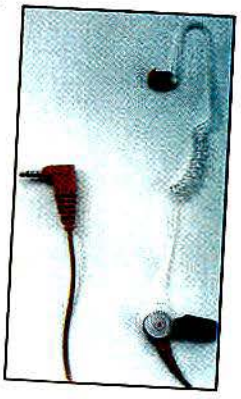
Over-the-air programming of customer validation and invalidation has been added to the model RLC trunking controller from **IDA.** The LTR-format controller is designed for use in all frequency bands including UHF and VHF. Standard features include compatibility with EFJohnson RDB and Uniden RNDL, quick invalidation, systemwide airtime data collection, systemwide validation and cross-busy circuitry. Cross-busy circuitry allows LTR-format trunking on non-exclusive channels. Designed to protect against causing co-channel interference, this feature will not allow LTR radios to transmit if co-channel users are detected. This feature also allows the controller to share a repeater with a conventional tone panel.



Circle (401) on Fast Fact Card

Earphone kits offer right-angle plugs

Otto Communications' earphone kits for remote speaker microphones now feature right-angle plugs that discreetly connect into the bottom of any Otto speaker microphone. The right-angle plugs come in two sizes: 2.5mm for use with all Otto brand speaker mics and 3.5mm for other model speaker mics. Earphone kits are available with a 30" straight cord or a coil cord that extends to 30" in length. All earphone kits (offered in beige or black) come complete with earphone, acoustic tube and rubber eartip.



Circle (402) on Fast Fact Card

VHF repeater operates as trunking system

The TKR-740 from **Kenwood Communications** is a VHF repeater that can be configured as a VHF base station or as a multichannel, high-power, continuous-duty trunking system. The repeater can also be used in a single-channel, conventional repeater configuration. In a multichannel configuration, as many as five full channels can be placed in a single seven-foot rack. The unit, which can be used in a cabinet or as a desktop unit, can be rack- or cabinet-mounted.

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BNC/TNC connectors can mate securely

The QDM series connectors from **Tru-Connector** are positive-locking, quick-disconnect designs with BNC/TNC interface dimensions that can be installed and removed without tools. It features a female connector with a mating groove that accepts the male, which has to be manually pulled back before sliding forward to let three self-contained balls seat by "clicking" into place. The connector provides a secure quick-disconnect connection. Constructed from brass bodies with Tru-lustre or silver finish, silver or gold finish contacts and Teflon insulators, the connectors are rated for 1,000 Vrms, operate from dc to 11GHz and have 50Ω impedance. They fit 0.100" through 0.425" diameter cables and cannot be cross-threaded or vibrated loose.

Circle (404) on Fast Fact Card

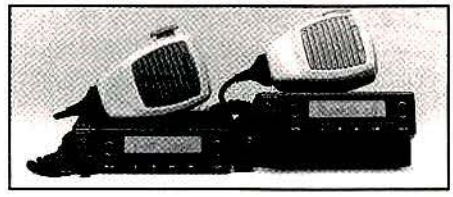
Program provides public safety products

The **Novatel Wireless** Missionone public safety program provides a complete set of specialized wireless communications products and services geared to the mission-critical needs of public safety agencies. Specialized public safety products with unique software and dedicated supports are offered through this program. All Missionone products, based on Novatel Wireless' commercial product line, will allow public safety employees to perform wants and warrant checks, transmit reports, send and receive email, and connect to local, state and federal databases wirelessly. Planned Missionone products include public safety versions of the Merlin PC card, the 3W modem and the Viking ruggedized laptop.

Circle (405) on Fast Fact Card

Mobile radios offer alphanumeric paging

Kenwood Communications' TK-980/981 800MHz and 900MHz mobile radios feature the Fleetsync for built-in alphanumeric two-way paging. In LTR trunking mode, the mobiles have a capacity of 32 systems with multiple talk groups. The mobiles offer selective calling with caller ID, allowing calls to be made from a pre-programmed 32-unit ID list or by direct-dialing on a DTMF keypad. They also have digital ANI PTT ID and emergency ANI and calling features, so a pre-arranged emergency status message sequence can be triggered. Status messaging allows messages to be stored in memory for later review, and it allows a selection of 32 pre-programmed test messages to be sent. Automatic status response enables a radio in status select mode to automatically respond to requests with pre-programmed messages such as "out of service" or "unattended." Radio stun and resurrect commands allow selective over-the-air radio disabling and restoration. Each unit's pre-assigned electronic serial number (ESN) is tagged to messages for origin identification.



Circle (406) on Fast Fact Card

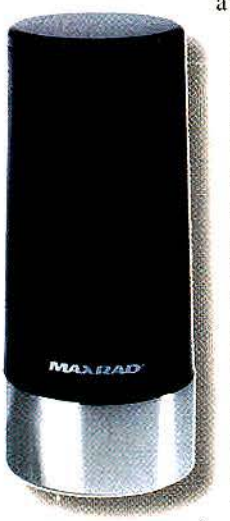
Console system displays unit ID numbers

The Scrutinizer from **Know Ideas** is a console display system that allows police dispatch operators to see unit ID numbers, associated unit names and time stamps in real-time, as officers key up their radios. The ID information displays on a video monitor screen and logs to a hard disk for archival and reporting purposes. The system interfaces to the console and displays the most recent 10 (or more) received unit IDs. Police dispatchers can view incoming unit numbers in case of key-up conflicts. In a man-down situation or other emergency, the system is designed to work with conventional (non-trunked) radio systems. It makes use of Motorola console products and radios capable of using the MDC-1200 signaling system.

Circle (407) on Fast Fact Card

UHF antennas offer minimum loss

Maxrad has expanded its line of MLPV low-profile vertical antennas with three UHF models. These models feature a brass radiator design, with minimum loss and no tuning required. Models MLPV406, MLPV440 and MLPV470 cover frequencies from 406MHz to 440MHz, 440MHz to 480MHz, and 470MHz to 512MHz, respectively, with a VSWR of less than 1.5:1 across the UHF bands. Their 3⅜" solid sleeve housing makes them suitable for any indoor or outdoor, mobile or fixed application requiring high performance with minimal visibility. They can be easily installed in a standard ¾" hole-mount mechanism that makes antenna replacement simple and economical.



Circle (408) on Fast Fact Card

Recorder allows more voice accessibility

Dictaphone's Freedom is an open-architecture recording system that gives public safety communications centers built-in protection from obsolescence. Using standard file access methods like SMB, NFS and FTP, the system allows users to take advantage of any existing or anticipated future storage device. The plug-in telecommunications interfaces and operating system-independent architecture mean that the system can easily adapt should an agency upgrade its phone system, operating system or network. The system also provides public safety operations with more ways to access and share voice recordings than conventional recording systems. The network-ready design and standard audio file format make voice files accessible over any LAN/WAN, Internet or Intranet, using any multimedia PC.

Circle (409) on Fast Fact Card

Microwave radio offers capacity capabilities

The Constellation digital microwave radio from **Harris** has multiple DS1 and single DS3 capacity capabilities. It is a compact, medium-capacity, point-to-point digital microwave radio that features the flexibility of synthesized radio frequency generation for easy redeployment to different sites. The architecture is suited for reconfigurations to accommodate different frequency and capacity needs. It offers capabilities of 8DS1, 28DS1 and 1DS3, along with alternative paths for future capacity upgrades. Different modulation states are used to match bandwidths to achieve high system gain for each capacity. Users can perform remote electronic inventorying for tracking installed modules. Remote software downloads can be completed in less than 10 minutes from any site. The radio offers an optional keypad that enables users to configure a system, monitor alarms or diagnose a problem. An optional service channel provides one voice and one data channel, and T1 interfaces can be individually programmed for line coding and length.

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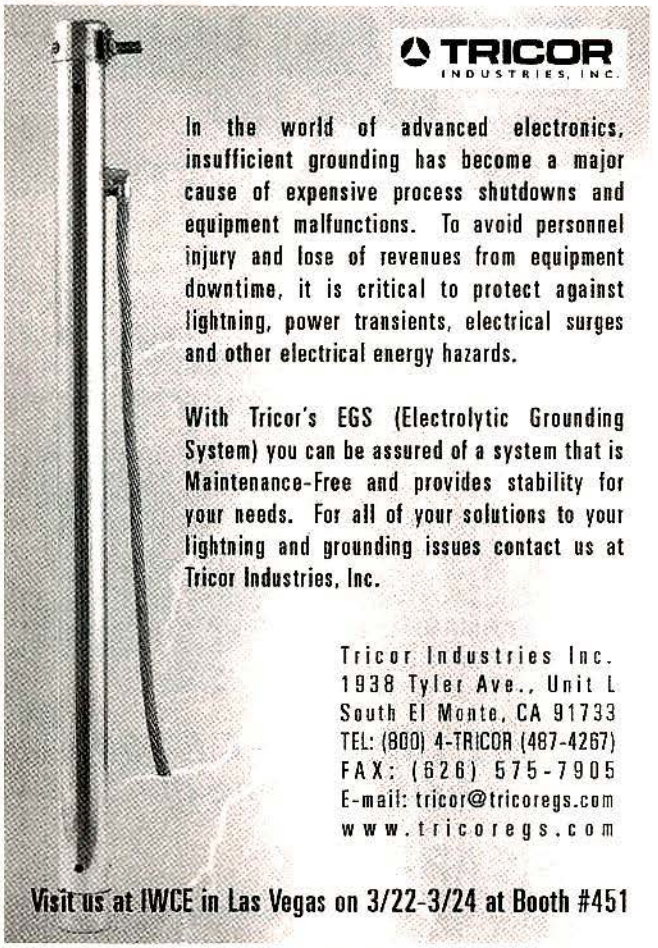

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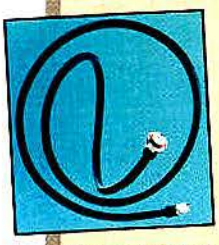
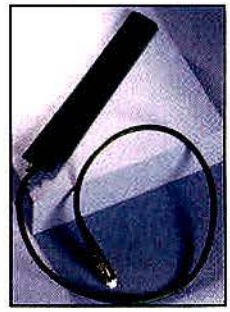
Cable assemblies offer low loss



Flexwell foam-dielectric jumper cable assemblies from **RFS Cablewave Systems** are constructed of corrugated foam-dielectric copper cables and Spinner connectors. They are built using a factory-automated process that solders the inner and outer conductors of the connector to the inner and outer conductors of the cable. The connector-cable assembly is then secured inside an injection-molded enclosure that provides strength and a waterproof seal. These jumpers, usually used between main feeders and antennas or from main feeders to transceivers, are suitable for indoor or outdoor applications. The jumpers are available in 1m, 2m and 3m lengths and made with ½" super-flexible or ½" standard low-loss foam dielectric cable and common connectors.

Circle (411) on Fast Fact Card

Stealth antenna design mounts anywhere



Larsen Antenna Technologies' Stealth Blade antenna is designed for UHF, SMR, cellular, dual-band cellular/PCS and the ISM bands at 900MHz and 2.4GHz. The conformal design of the antenna makes it suitable for applications where a traditional whip antenna is not practical. The antenna uses printed circuit technology to provide 2.14dBi performance and superior impedance bandwidth. Its slim design allows it to be mounted virtually anywhere without obstructions, such as in vehicles for data and voice, mobile computing or other mobile and portable terminal applications. The antenna can also be concealed inside the lining of garments worn for covert communications operations.

Circle (412) on Fast Fact Card

Transceiver avoids TETRA interference

Wood & Douglas' versatile, credit-card-sized transmitter-receiver is for the 868MHz–870MHz license-exempt telemetry band. Type-approved to the European EN 300 220 (telemetry) and more demanding ETS 300 086 (mobile radio) specifications, the SX850 transceiver is for manufacturers of professional short-range telemetry and data exchange systems for on-site monitoring, control and security. In such applications, the pan-European 868MHz–870MHz band currently provides an interference-free alternative to the United Kingdom's crowded 418MHz, 433MHz and 458MHz license-exempt bands. These bands have been prone to disruptive interference since the recent introduction of the TETRA trunked radio allocation at and around 420MHz. Besides low-power (5mW) output for short-range applications, the transceiver offers a high-power mode providing 500mW output for longer range telemetry systems.

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Modem module offers two analog inputs

The SLM-C module (singular) from **RF Neulink** for the RF9600 series radio modems provides two analog inputs and two analog outputs and is configurable for 0V to 5V input or 0mA to 20mA input. The parts may also be configured as

outputs for the same ranges. This module is useful in remote monitoring operations, sensing machine current changes, control loop circuitry and temperature monitoring.

Circle (414) on Fast Fact Card

Headset suits SWAT, infantry applications

Television Equipment Associates' Cobra headset for infantry, SWAT and general communications applications is compatible with military helmets and specialized headgear. The headset fits under a range of infantry helmets including PASGT, ski-troop parka hoods, paratroop helmets and chemical and biological hoods. The headset, which is lightweight, comfortable and waterproof, will not fall off during aggressive action. The Cobra adjustable boom arm mic can be supplied for either military green radios or for commercial electret radios. A quick-release connector is provided between the headset and the press-to-talk assembly, which accommodates the incorporation of the lower cordset into ballistic and armor vests. Hearing is not obstructed in close-quarter battle because the close-coupled, supra-aural earphone "stands off" from the user's ear so he can hear ambient sound.

Circle (415) on Fast Fact Card

Site analyzer addresses troubleshooting

The 1900 base site analyzer (BSA) from **IFR** is a comprehensive tester that addresses the field installation and troubleshooting needs of Ericsson, Lucent and Nortel infrastructure equipment. Test times can be reduced, and training can be simplified further, with IFR's Autocell automated test software. This software will verify the RF integrity of new equipment installation, including modulation quality, adjacent channel power, and analog and digital mode output power. It will also perform RSSI calibration tests for the dual-diversity and the newer quad-diversity receivers. The user-friendly program interface displays results as the test progresses and takes the guesswork out of instrument setup. A new series of user-defined training programs is available to 1900 BSA users. The base site analyzer meets TIA/EIA-136 specifications in the 400MHz, 800MHz and 1,900MHz bands. It provides full-service monitor functionality from 10MHz to 2GHz.

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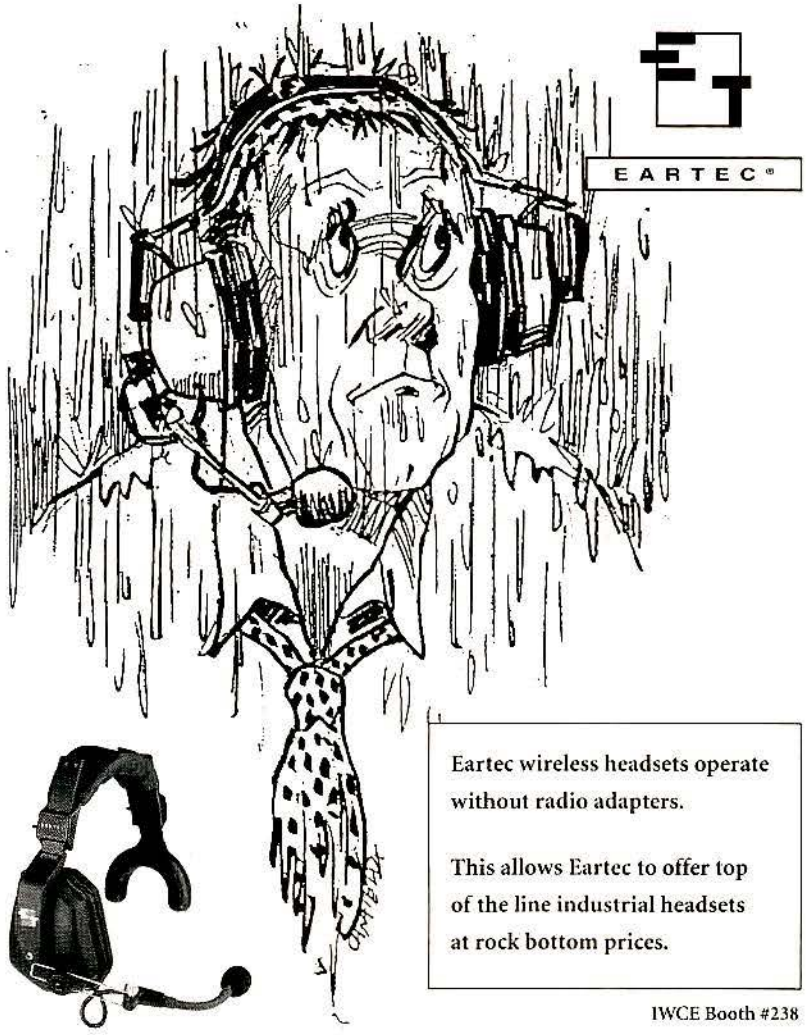
Tired of Getting Soaked When You Buy Headsets?



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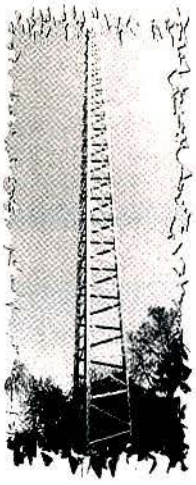

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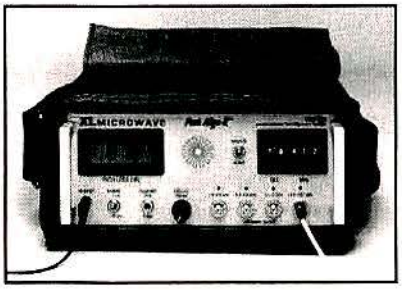
Point-to-Point μwave Antenna Path-Alignment Test Set



The *Path Align-R* is simply the most cost effective test solution on the market for μwave antenna path alignment. The *Path Align-R* displays path loss in dB and *provides voice communication over the link...while aligning ...at the back of the antenna...up the tower!*

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Paging transmitter supports 200 pagers

The VS2001 Pagecall paging system from **Visiplex** sends alphanumeric, numeric, tone-and-voice or tone-only messages to as many as 200 pagers, with options to accommodate as many as 1,000. Pages can be initiated through the keypad, telephone, contact closures and RS-232 serial port. It also features a 2W internal transmitter and a slim-line, high-tech antenna. The system has individual and group call capability and seven contact-point inputs. A numeric keypad and two-line, 16-character LCD are included.

Circle (417) on Fast Fact Card

Two-way radios allow multiple communicators

Motorola's Sprint GT professional two-way radio provides the ability for several people to talk to each other simultaneously at the push of a button. The radios enable instant on-site communications for businesses requiring immediate access to their staff. The radio is a sleeker, next generation "walkie-talkie" with a feature set and a compact, lightweight framework designed for commercial application. Developed to withstand the rigors of daily use, the radios come with built-in, hands-free capability and professional-quality amplification to help combat high ambient-noise levels. The radios feature a call-tone function to alert users of an incoming transmission. The radios are available in one-channel and two-channel models and operate on frequencies reserved exclusively for business use. Each radio features a built-in interference eliminator to help block out unwanted channel chatter, and each has a talk range of as much as 200,000 square feet and 15 floors indoors, depending on structures, terrain and conditions.

Circle (418) on Fast Fact Card

RF modem changes to an N connector

The latest version of the Blue Streak frequency-hopping, spread-spectrum RF modem from **Aerotron-Repco Systems** includes a change to an "N" connector for connection to the antenna systems. The normal interface is RS-485, unless it is connected to an RS-232 connector, in which case it defaults to RS-232. The redesigned enclosure will offer a more rugged extruded aluminum enclosure designed for high-stress applications.

Circle (419) on Fast Fact Card

CDMA source tests power amplifiers

The Zebra II from **Berkeley Varitronics Systems** is a 16-channel CDMA source suitable for testing power amplifiers according to IS-97 specifications and simulating ANSI-95 forward channels. As many as seven adjacent carriers are supported with user-selectable or customizable waveforms that can be generated and imported using the included software.

Circle (420) on Fast Fact Card

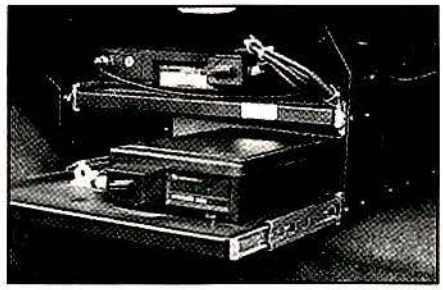
TDR locates faults on metallic cable

Riser-Bond Instruments' model 1550 hand-held TDR locates faults in short- or long-range applications on all types of metallic cable. The ergonomic design and weatherproof housing make this compact TDR a versatile troubleshooting tool. Automatic attenuation compensation ensures that all faults, whether near or far, are easy to locate on a full cable. The TDR locates faults from three feet to more than 9,000 feet with ±1% accuracy. The small size and low cost make the TDR a suitable tool for technicians, linemen and construction employees. The backlit LCD is easy to read in low light, and the rugged design is resistent to all types of weather.

Circle (421) on Fast Fact Card

Radio shelf offers clean, easy installations

Gamber-Johnson's trunk-mounted radio shelf provides clean installations and easy access. The shelf is designed for mounting radios in the trunks of Ford Crown Victorias. It offers a sturdy, steel non-flammable construction and a safety snap pin with lanyard. The no-holes-bored design makes installation easy with no drilling required. It may be ordered with a single shelf or double shelf. The second shelf may be added later as more mounting space is needed for additional equipment. Fully extendable ball bearing slides allow gliding shelves to be removed for easy installation and equipment repair. The single shelf weights 21.4 pounds; the double



shelf is 29.6 pounds. The trunk-shelf also has a large mounting surface, featuring shelf dimensions of 13¼" × 24". It is also designed with 4¾" of space between shelves to accommodate popular radios.

Circle (422) on Fast Fact Card

Decoder works with MDC-1200

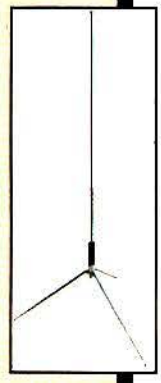
The C-mark decoder from **Cimarron Technologies** is MDC-1200-compatible. A portable or mobile radio transmits ANI data to the base station, where C-mark units decode and display GE-STAR or MDC-1200 data. The data are formatted into an RS-232 ASCII string of characters suitable for CAD or printer use. Four models are available, with capabilities ranging from a basic computer interface

to a multiwindow dispatch display unit. A man-down alert, emergency situation or stuck mic condition can instantly be identified. Decoded data are time-stamped and have a 12-message buffer for review.

Circle (423) on Fast Fact Card

Antenna is for field exercises

The compact, portable field antenna from **STI-CO Industries** is a pocket-size, easy-to-use unit that is designed for temporary field deployments, stakeouts or field exercises. It can be used on the ground or it can be suspended from high locations such as tree limbs, poles, building overhangs or bridge trusses. The triangular base antenna is five feet high, and fully extended, collapses to 10 inches. It is suitable for low-power field radios where communications efficiency is needed. The antennas, when hung from above, use sliding lanyard tie-off cords. The lightweight 6dB gain antennas are available in VHF narrowband or broadband frequencies.



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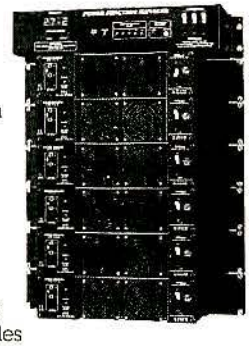

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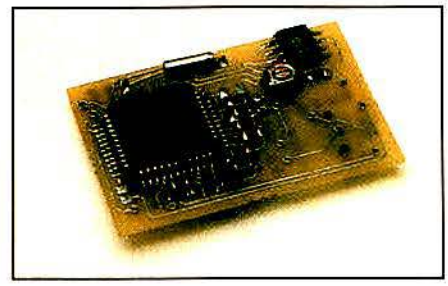
Software expands analysis capabilities

Anritsu's Spectrum Capture custom software expands the analysis capability of the MS2650/MS2660 series of spectrum analyzers. Using the new software, users can capture, analyze, store and recall data on a PC, making signal analysis more precise and functional. Measurements can be taken at user-selected times and frequencies by the spectrum analyzer. The data can then be transferred to a PC for detailed analysis. The data can also be saved and recalled at a later date for comparison with other measurements. Users can pull up multiple traces simultaneously and create a trace overlay.

Circle (425) on Fast Fact Card

Logic board supports Kenwood radios



SmarTrunk Systems' ST-865KW4 Smartrunk II logic board is for the Kenwood "G" series radios. The board is configured for plug-in installation in the "G" series mobile and portable radios. The logic board offers the latest implementation of the Smartrunk II Omni feature set for large-fleet dispatch and multisite roaming applications. The Omni features include: multiple channel bands for operating on as many as 16 RF systems; as many as 16 PTT talk groups; multiple-receive groups; Smartscan for faster channel access; positive radio kill to disable a lost or stolen radio; Turbo Speedial for one-button dialing of frequently called numbers; and PC programming with the Kenwood KPG-56D programming software. Designed for dispatch and telephone interconnect applications, the Smartrunk II digital trunking system is for applications below 800MHz. Features include more than 300,000 user IDs for channel privacy and system security, unlimited selective calling to both individuals and groups, provision for fleet and emergency calls, and the ability to remotely disable a lost or stolen radio.

Circle (426) on Fast Fact Card

Equipment rack arrives knocked down

The model V8806 equipment rack from **Winsted** is a 78¾" all-steel vertical rack that comes knocked down for lower shipping costs. The model's extended height provides 45U (45 rack units) of usable rack space and has overall dimensions of 83¼" × 22⅛" × 26". The heavy-duty steel rack has an attractive mar-resistant, black textured enamel finish and comes complete with vented sides, an open base for cabling and adjustable punched rack rails with lacing bar. Other models in this knocked-down line include a 35" high (20U) and 70" high (40U) version.

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PEOPLE

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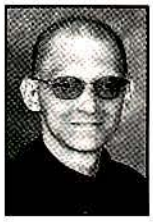
Cirota

Melchione

Changes at PanaVise Products, Reno, NV:

Kathy Wood departs Philips Communications, Security and Imaging, as senior customer service representative to join PanaVise's inside sales department. **Patty Bruns** joins PanaVise as accounting manager after working as the controller for a company that produced estate planning documents. **Jeremy Cirota** leaves Maxton Manufacturing, Carson City, NE, as design engineer to join the company as product design engineer.

Rocco J. Melchione, sales and marketing manager at Hirose Electronic (U.S.A.), Simi Valley, CA, advances to vice president of sales and marketing of the Americas.

Doug Musser joins DX Radio Systems, Sun Valley, CA, as eastern regional manager for the Land Mobile Radio and Paging Infrastructure Products Division after working with companies such as CTI, Bill Brown Company and Norark Communications.

Changes at Radio Frequency Systems, Meriden, CT, in conjunction with the merger with Celwave, Marlboro, NJ:

William A. Bayne Jr., senior vice president of operations (RFS Cablewave), advances to senior vice president of sales and marketing for RFS Americas. **Charles H. Linke,** vice president of sales and marketing for RFS Cablewave, becomes vice president, national/carrier sales for RFS Americas. **Richard Chocolate,** vice president, sales, with Celwave, is promoted to vice president, OEM sales for RFS Americas. **Jeff Krane** becomes vice president, Latin American sales. **Andy Singer,** director of technical marketing with Celwave, advances to director of marketing/tech services for RFS Americas. **Richard T. Copley,** market development manager for Celwave, becomes product manager, filters and combiners for RFS Americas. **Magdy Michael,** product manager, active devices, for Celwave, is promoted to product manager, active devices and wireless distributive communications systems for RFS Americas. **Asad Zoberi,** sales engineer for RFS Cablewave, advances to product manager for microwave and base station antenna and transmission line systems for RFS Americas.

Changes at Andrew, Orland Park, IL:

Elizabeth A. Fetter, president of NorthPoint Communications, Chapel Hill, NC, is elected to Andrew's board of directors. **William O. Hunt,** chairman of the board at Internet America, Dallas, also joins Andrew's board of directors.

Daniel R. Pearson, vice president of strategic management and business development for Harris' Government Communications Division located in Palm Bay, FL, advances to president of the Communications Products Division headquartered in Novato, CA.

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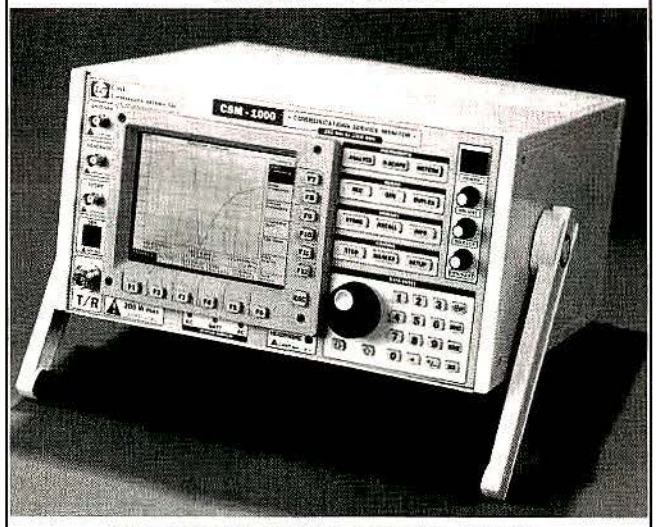

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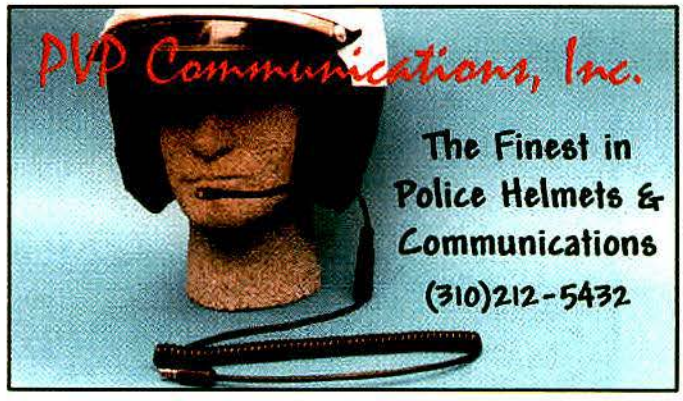

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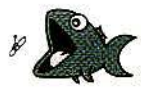

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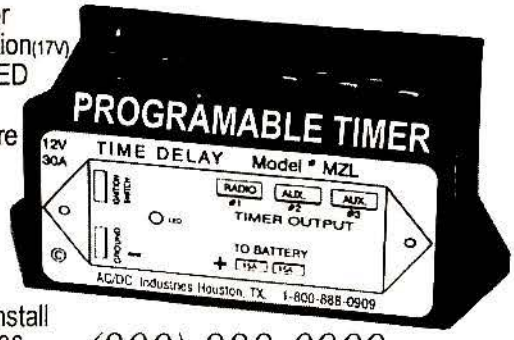

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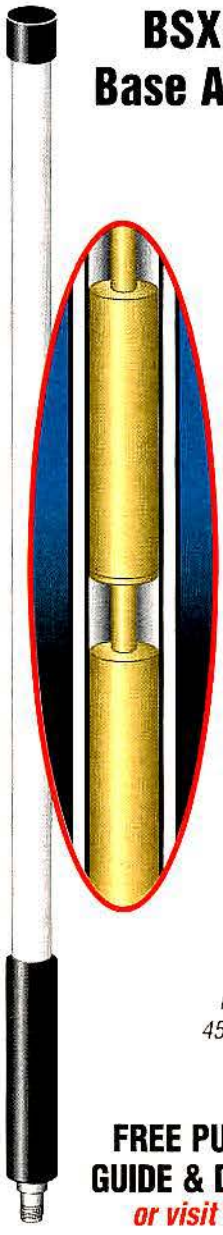

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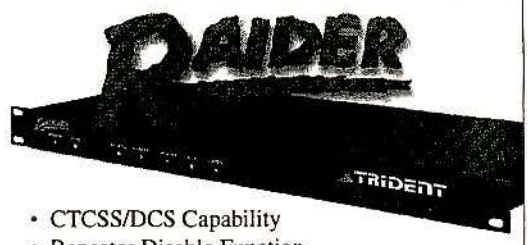

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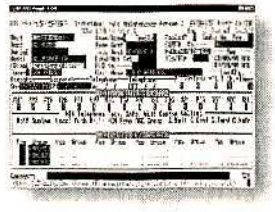

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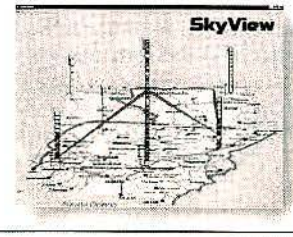

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Noise Figure:	<5dB
Frequency Bands:	
50368FS-L	928.00625 to 928.99375MHz
	932.00625 to 932.49375MHz
50368FS-U	941.00625 to 941.49375MHz
	952.00625 to 952.99375MHz
Channel Spacing:	6.25kHz
	12.5kHz
	25kHz

***We're so confident that Ultra-Q will solve your interference problems, we offer a 30 day trial!**

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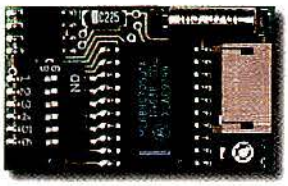
Ultra-Q 5/11/98



SS-64 $28.95
Microminiature DIP Switch Programmable CTCSS Encoder.
Includes 64 tones from 33.0 to 254.1 Hz.
.66" x 1.08" x .21"

TS-64 $54.95
Sub-miniature Programmable CTCSS Encoder-Decoder.
Includes 64 tones from 33.0 to 254.1 Hz.
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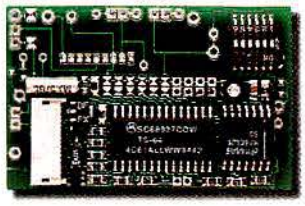

TS-64DS $57.95
DIP Switch Programmable CTCSS Encoder-Decoder.
Includes 64 tones from 33.0 to 254.1 Hz.
1.25" x 2.0" x .30"

ANI-1/$39.95 **ANI-2/$299.95**
Automatic Number Identification System
ANI-1 Encoder - 1.13" x .66" x .22"
ANI-2 Station Decoder - 5.4" x 5.8" x 1.4"

ID-8 $69.95
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ID Requirements. Fully field programmable
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TP-3200 $279.95
Full Featured Shared Repeater Tone Panel with ALL 157
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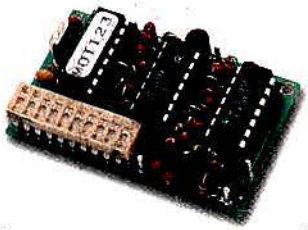
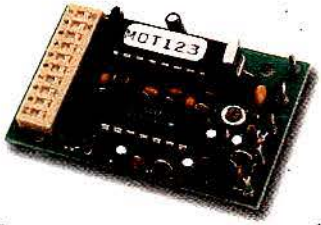
PE-1000 $224.95
Desktop Paging Encoder. Two-Tone Sequential,
other formats available. 7.5" x 7.8" x 2.7"



SD-1000 $59.95
Two-Tone Sequential Decoder. Programmable unit
provides switched outputs from Two-Tone paging calls.
1.25" x 2.0" x .4"



PE-2P $54.95
Two-Tone Sequential Encoder. Sub-assembly mounts
inside radio or other enclosure. Multiple call capability.
1.25" x 2.0" x .4"

DCS-23 $59.95
Digital Coded Squelch Encoder-Decoder. Programmable
to all 106 DCS codes. 1.36" x 1.18" x .25"

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